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GEOGRAPHICAL REVIEW

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Separate Maps published in the *Geographical Review* and the *Bulletin of the American Geographical Society*, the majority in color. 25 cents each. A list will be sent upon request.

THE GEOGRAPHICAL REVIEW

VOL. XVII OCTOBER, 1927 No. 4

A TOWN THAT HAS GONE DOWNHILL

James Walter Goldthwait

Dartmouth College

[With separate map, Pl. IV, facing p. 552]

"AGRICULTURE is, and always will be, the chief business of the people of New-Hampshire, if they attend to their true interest." So wrote Jeremy Belknap, first historian of the state, in 1792.[1] And for thirty years, at least, his words were echoed by authors of successive "gazetteers." Now, for almost a century deserted farms in New Hampshire have been growing up to blueberry pasture, woodland, and forest. The sturdy population that was once evenly distributed over thousands of square miles of the stony upland has slowly and steadily moved down from the hilltops, emigrating to distant places, or lingering yet awhile in the valleys. Large tracts of land have been abandoned or have become the summer homes and playgrounds of well-to-do vacation seekers from the cities.

The downhill movement, particularly, came to my attention a few years ago, while making a topographic map of the township of Lyme. Since the eastern half of this township is deserted country with scarcely an occupied house and very few traveled roads, it became a matter of practical interest to locate all such landmarks as abandoned roads and stone walls, cellar holes, orchards, and other signs of former culture. As this work progressed, comparison with the earliest detailed map then known to me—the map of Grafton County by Walling, in 1860[2]—on which every occupied house is shown with name of occupant, disclosed the fact that certain cellar holes mark sites of houses that were abandoned before 1860. An

[1] Jeremy Belknap: The History of New Hampshire, 3 vols., Boston, 1791–1792; reference in Vol. 3, p. 142.

[2] H. F. Walling: Topographical Map of Grafton County, N. H. Scale 1:70,000. New York, 1860.

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FIG. 1

FIG. 2

FIG. 3

FIG. 1—An unoccupied house on the Dorchester road (see Pl. IV, facing p. 552).
FIG. 2—Deserted schoolhouse of the Acorn Hill district.
FIG. 3—On the road to Hardscrabble. Smart's Mountain in the distance.

FIG. 4

FIG. 5

FIG. 6

FIGS. 4 and 5—The Colonel Selah Beal house, falling to ruin on the Dorchester road under Smart's Mountain.

FIG. 6—An old farmhouse only recently left unoccupied.

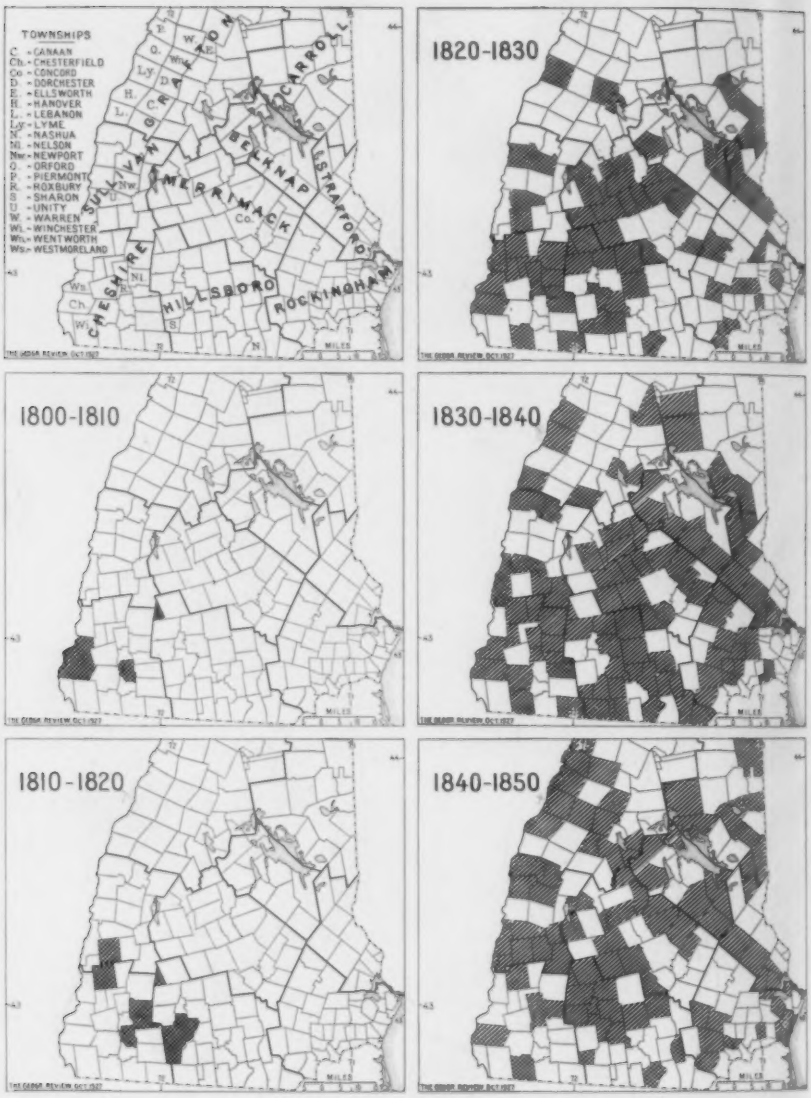


FIG. 7—Maps of central and southern New Hampshire showing losses in population by townships for each decade in the first half of last century. A key map names the counties and the tbwnships referred to in the text. Scale 1:3,250,000.

effort was made, therefore, to discover as many of these pre-1860 cellar holes as possible and thus to obtain data for a map that would show the extent of settlement of the township at the time of its maximum population, which was about 1830. While the results are by no means complete, because many cellar holes or house sites have been erased or lie hidden in a wilderness of forest, they form a basis for comparison with detailed maps of three later dates—the Walling

map of 1860, the map of Lyme in Hurd's Atlas of New Hampshire in 1892,[3] and the new map made in 1925. With these four maps it is possible to study the shift of population through the township, house by house, in three successive 30-year periods, or generations: 1830–1860, 1860–1892, and 1892–1925.

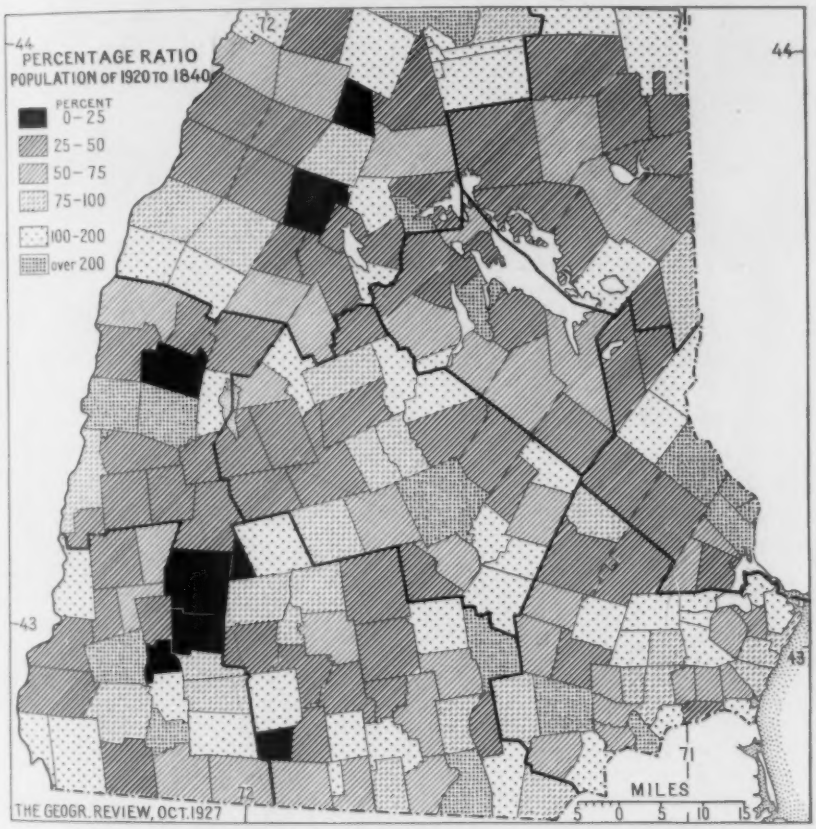


FIG. 8—Map of central and southern New Hampshire showing percentage of losses and gains in population by townships for the period 1840 to 1920. Scale 1: 1,400,000.

In order more fully to appreciate the movement of which this local flowage of humanity is a part, its history will first be briefly sketched.

THE INCOMING TIDE OF THE EIGHTEENTH CENTURY

The interior of New Hampshire, and particularly the upper portion of the Connecticut valley, to which attention is to be drawn, was settled mainly by farmers from Connecticut just after the close of the French and Indian wars. According to Belknap the number of people

[3] D. H. Hurd & Co.: Town and City Atlas of the State of New Hampshire. Map of Lyme township on p. 194. Scale approximately 1¼ inches to the mile. Boston, 1892.

in this state doubled in less than 19 years, before the year 1790, notwithstanding the fact that seven of these years were years of war.

> Where land is cheap, and the means of subsistence may be acquired in such plenty, and in so short a time as is evidently the case in our new plantations, encouragement is given to early marriage. A young man who has cleared a piece of land, and built a hut for his present accommodation, soon begins to experience the truth of that old adage "It is not good for man to be alone." Having a prospect of increasing his substance by labour, which he knows himself able to perform, he attaches himself to a female earlier than prudence would dictate if he had not such a prospect. Nor are the young females of the country averse to a settlement in the new plantations; where, after the second year's labour, by which the land is brought into pasture, there is a necessity for beginning the work of a dairy; an employment which always falls to their lot, and is an object of their ambition, as well as interest.[4]

Abundant evidence remains of the vigor and hopefulness of these pioneers. With their ox teams they cleared incredible areas of hill country. Trees were chopped down or burned, stumps were uprooted, field stone was dragged off to make walls along every road and around every pasture; and crops sprang up on every sunny hillside. Wood lots were left only on north slopes and in tracts absolutely too rough for cultivation. These farmers were bold in their choice of land to occupy and clear. They usually preferred the hillsides to the flat or terraced valleys, because the hills were better drained and because their soil, though more stony, appeared less liable to become exhausted with use than the lighter loam of the valleys. There was no lack of cordwood to warm the houses through the long cold winter; and lumber was to be had without limit, for the sawing. Sawmills and gristmills were built as soon as log huts, and frame houses quickly followed. These were simple but substantial.

> Land being easily obtained, and labour of every kind being familiar, there is great encouragement to population. A good husbandman, with the savings of a few years, can purchase new land enough to give his elder sons a settlement, and assist them in clearing a lot and building a hut; after which they soon learn to support themselves. The homestead is generally given to the youngest son, who provides for his parents, when age or infirmity incapacitates them for labour. An unmarried man of thirty years old is rarely to be found in our country towns. The women are grandmothers at forty, and it is not uncommon for a mother and a daughter to have each a child at the breast, at the same time; for a father, son and grandson to be at work together in the same field. Thus population and cultivation proceed together, and a vigorous race of inhabitants grows up, on a soil, which labor vies with nature to render productive.[5]

Every house had a cellar walled with boulders collected from off the place; and doorsteps and hearthstones were carefully selected from flat-splitting blocks or ledges in the neighborhood. Apple orchards, at first wholly for cider but later for "eating apples," were planted

[4] Belknap, *op. cit.*, Vol. 3, pp. 237–238.
[5] *Ibid.*, pp. 260–261.

FIG. 9

FIG. 10

FIG. 9—The ox team was an essential of the pioneer's equipment.
FIG. 10—Rolling a town road after a snowstorm.

around every homestead. Sugar maple orchards were given much care and are still producing quantities of fine syrup.

Altitude and distance from the village seem to have counted little with these settlers. What did it matter if there was a five or six mile journey across the township, in days when the vehicle was an oxcart and when any one in a hurry went on horseback? There was little occasion to go farther than the nearest village store or blacksmith shop. Each neighborhood was practically self-supporting. A journey to a distant city like Boston or Hartford was an unusual event and took days.

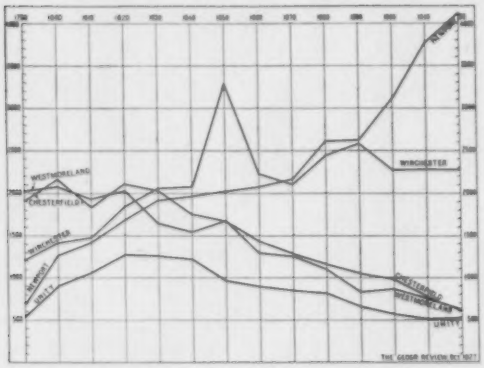


FIG. 11—Graph showing population of Newport and Unity townships and of Winchester, Chesterfield, and Westmoreland townships from 1790 to 1920.

One tramping over these deserted hill farms now is struck with the thought that loneliness was somehow at the root of the process of abandonment. But a consideration of the map shows little basis for that idea. Houses were not far apart. However lonely the country has become, that must not be counted among the original reasons for its abandonment, but rather as a consequence of it. Moreover, life for these people was too earnest to be dull. "The people of New-Hampshire, in general, are industrious, and allow themselves very little time for diversion. One who indulges himself in idleness and play, is stigmatized according to his demerit."[6]

THE TURNING OF THE TIDE TOWARD THE WEST

Early in the nineteenth century the tide of population stopped rising and began at once to subside. By 1840 it was falling generally throughout the state. On the maps in Figure 7 can be seen the way in which this condition of ebb tide spread northward across the upland between 1800 and 1840.

No doubt the country had been somewhat overpopulated, as a result of the processes reviewed by Belknap; for these hill farms were not all productive, and they became less so as successive crops were harvested and fields were not sufficiently fertilized. The discovery of that discouraging fact must have come at an early date, although one finds scarcely an admission of it for several decades in the optimistic gazetteers of the time. It is not until 1860 that we read that "the

[6] *Ibid.*, pp. 262–263.

FIG. 13

FIG. 14

FIG. 15

FIG. 13—The last occupied house on the Dorchester road.
FIG. 14—A connected "set o' buildings," still occupied, on the side of Plott Hill.
FIG. 15—An old sawmill that still does a small business. Lyme Center.

principal occupation of the people is in subduing a hard, silicious surface, and extorting from its reluctant lap the bread of toil."[7] Accounts of extraordinary crops of maize, wheat, barley, oats, and flax are offered, in close proximity to derogatory statements about western farms, which were attracting the New Hampshire farmer as early

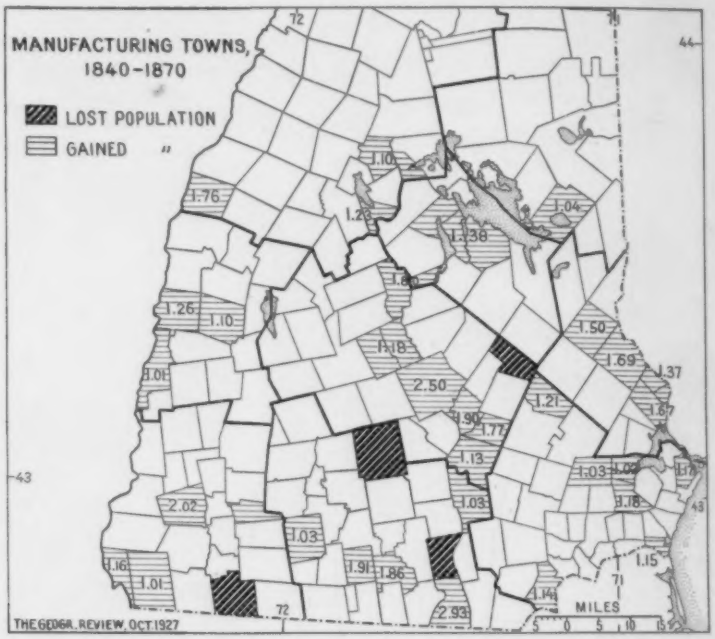


Fig. 12—Map of central and southern New Hampshire showing loss and gain in population in manufacturing townships from 1840 to 1870. The figures give ratio of gain. Scale 1:1,800,000.

as 1820 and increasingly for several decades. Hayward's Gazetteer of 1849, after quoting Dr. Jackson, the state geologist, regarding a cornfield on one of the islands of Lake Winnepesaukee, where careful agricultural methods resulted in a yield of 136 bushels to the acre, remarks:

> One would suppose that the fertility of the western prairie could offer little temptation to the farmer who might produce such a crop, and remain among his own paternal fields; especially when the contrast is made between the healthiness of a northern climate, in a high, hilly region, pure water flowing plentifully, all facilities for happily training a family; and a country where, indeed, labor is comparatively light, land cheap, and winters lose much of their rigor and length; but fever and ague sap the constitution, and send back the adventurer a lean, sallow invalid for life, or lay him prematurely in the grave.[8]

[7] A. J. Coolidge and J. B. Mansfield: History and Description of New England: New Hampshire, Boston, 1860, p. 396.

[8] John Hayward: A Gazetteer of New Hampshire, Boston, 1849, p. 22.

While this forbidding picture of the emigrant was being held up to readers of the gazetteer, the state continued to pour out farmers into the west at an alarming rate. Where most of them went is shown in Table I.[9]

The tendency for emigrants to go farther and farther west is seen in a comparison of the columns for 1860 and 1870.

TABLE I—NEW HAMPSHIRE IN ACCOUNT WITH OTHER STATES AND TERRITORIES AS REGARDS NATIVE POPULATION

STATE	DR. 1860	CR. 1860	NET LOSS 1860	NET LOSS 1870
Massachusetts . . .	44,035	19,973	24,062	31,269
New York	12,497	2,045	10,452	6,712
Pennsylvania . . .	1,773	227	1,446	1,545
Ohio	4,111	150	3,961	3,117
Indiana	1,072	28	1,044	979
Michigan	3,482	66	3,416	3,544
Illinois	7,868	104	7,764	8,022
Wisconsin	5,907	85	4,822	4,800
Minnesota	2,387	22	2,365	3,216
Iowa	3,287	18	3,269	5,000
California	2,552	15	2,537	2,653
Total, all States and Territories . . .	125,516	47,328	78,188	80,360

This account shows that 124,979 persons who were born in New-Hampshire are now [1870] living in other States in the Union; and that 46,282 who were natives of other States, now reside here—showing an emigration against us of 78,697, or a gain [i. e. increase in emigration] from the last decade of 2172, and probably without a parallel in any State or nation, this side of Ireland.[10]

THE MOVEMENT FROM FARM TO FACTORY

The decline in population in New Hampshire was not due simply to emigration following the discovery of better farms in the west. Another strong influence was at work. New Hampshire with the rest of New England was being transformed into an industrial region. This change began in 1800–1810, so slowly as scarcely to be recognized, but gathered strength and speed, so that by the middle of the century it had become a dominant factor.

To get a closer view of the influence of manufacturing in this early period, we may look again at the maps in Figure 7. Westmoreland and Chesterfield, near the southwest corner of the state, on the Connecticut River, were farming towns of large area and favorable situation which had reached a total population of 2000 by the year 1800. Next to them on the southeast is the township of Winchester, similar

[9] Based on census statistics taken from A. J. Fogg: The Statistics and Gazetteer of New-Hampshire, Concord, N. H., 1874, p. 451.

[10] *Ibid.*, pp. 451–452.

to them in size and topography, but crossed diagonally by the swift-flowing Ashuelot River. Although it was mainly a farming town, the mill sites along this stream had come into use at the very first. Between 1800 and 1810 Winchester grew in numbers from 1413 to 1478, while Westmoreland fell from 2066 to 1937 and Chesterfield from 2161 to 1839, starting a decline which has continued until the population is now approximately 35 per cent of what it was.

TABLE II—ECONOMIC CONDITIONS IN NEW HAMPSHIRE IN 1840 AND 1870

	1840	1870
Miles of railway	6	900
Pairs of boots and shoes manufactured	500,000	8,000,000
Cotton goods manufactured	$4,000,000	$30,000,000
Woolen goods manufactured	$800,000	$9,000,000
Total manufactured goods	$13,000,000	$95,000,000
Persons engaged in manufacturing	12,000	46,553
" " " agriculture	78,000	46,573

As the falling wave of population spread northward over New Hampshire, towns like Winchester which had water power came to be oases of prosperity in an otherwise afflicted upland country. The map, which shows losses from 1830 to 1840 in particular, indicates the comparative success and growth of towns along the Merrimack, Contoocook, Ashuelot, and Sugar Rivers. The contrast in the case of Newport and Unity, whose population curves are shown in Figure 11, is the same story in different form.

THE DISTURBING INFLUENCE OF THE RAILWAY

The first railway line to enter New Hampshire came up the Merrimack River in 1838 from Lowell, Mass., to Nashua, ending there within six miles of the border. By 1842 it had been extended up the river to Concord; and before 1850 there were connections northward and northwestward by several routes to the Connecticut valley, where Vermont and New Hampshire vied with each other for the advantages expected to come from rapid transportation. Most of the existing main lines of southern New Hampshire were in operation by 1850; and many branches were built between that date and 1870, linking the smaller towns to the larger by more crooked paths and uneven grades.

In the three decades 1840–1870 the railway was perhaps the strongest single factor affecting life in New Hampshire. Although it might have been expected to encourage farming as well as manufacturing, by putting the farmer within reach of Massachusetts markets, that

was not the result. The decline in rural population was not checked but rather intensified. Manufacturing centers grew faster than before. Rising generations of boys and girls felt the urge of the city. The difficulties of earning a livelihood on the small New Hampshire farm became more and more real as the scale of living on the farm rose in response to that of the industrial world. The movement from farm to factory was at last uncontrollable.

The economic transformation of these three decades is shown in Table II. Special attention is called to the last two pairs of figures. While the number of farmers and farm hands fell to about six-tenths the figure of 1840 the number of factory employees rose to almost four times the earlier figure, becoming as large as that of the farming population. Among the contributing factors should be mentioned the introduction of farm machinery which greatly reduced employment on the farm at the time when manufacturing offered abundant opportunity.

The greatest gains were made in the Merrimack valley, where opportunity for power development on a large scale and accessibility to Massachusetts attracted capital; and the cities of Manchester and Nashua, in particular, had phenomenal growth. In several cases industrial growth led to partitioning of old townships into new ones, one mainly industrial and the other agricultural.

The Development of a Summer Migration

The growth of the nation in industry after the seventies, and particularly that of southern New England, brought with it an increasing allotment of time to leisure and recreation. The summer vacation became a vital part of the calendar for hosts of people. Hotels in the White Mountains region grew in number and popularity, and farmhouses began to look for summer boarders. As summer visitors felt the spell of mountains, hills, forest, and lakes, they began to purchase lake-shore lots for camps and cottages, or to buy deserted farms and rehabilitate them. This process is still going on rapidly, after thirty or forty years, without exhausting the supply of desirable places. In fact, there are some townships, like Lyme, in which summer still brings little increase in population. The repairing of the old buildings and clearing up of "the place," though usually without much outlay of money (measured according to city standards), and the occupying of so many farms for even a few months every year have brought employment to a great many year-round inhabitants who act as caretakers, gardeners, painters, and carpenters and furnish fresh vegetables, milk, eggs, and transportation. Country stores that are little more than neighborhood post offices during the winter carry a large and elaborate stock of groceries from late June till mid-September.

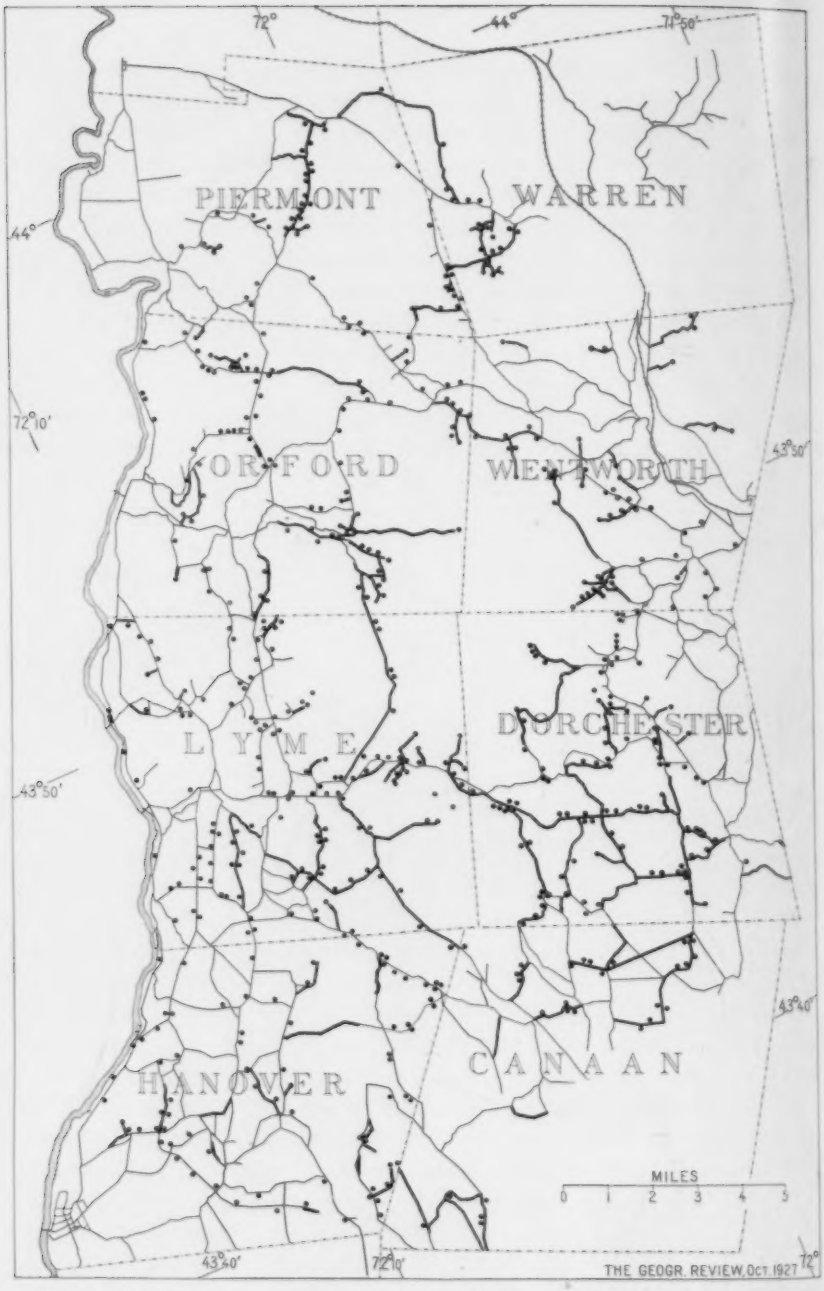


Fig. 16—Map showing the extent of desertion of roads and houses in the region about Lyme, N. H. The dots represent deserted houses, and the heavy lines deserted roads; roads still in use are shown by a light line. On the west the Connecticut River. Compare Figure 17. Scale 1:260,000.

During the last fifteen or twenty years the growth of well organized and advertised boys' camps and girls' camps through the state has added still another opportunity to the native population to increase their earnings. Large state and national forests reserves, chiefly in the central and northern parts of the state, trail-cutting, and the establishment of overnight camps and huts by such organizations as the Appalachian Mountain Club have made mountain climbing comfortable and attractive. The scenic features of New Hampshire have come to be regarded as her most precious resource, and countless acres on which serious-minded pioneer farmers and their ox teams toiled a century ago are now delighting a generation of city dwellers.

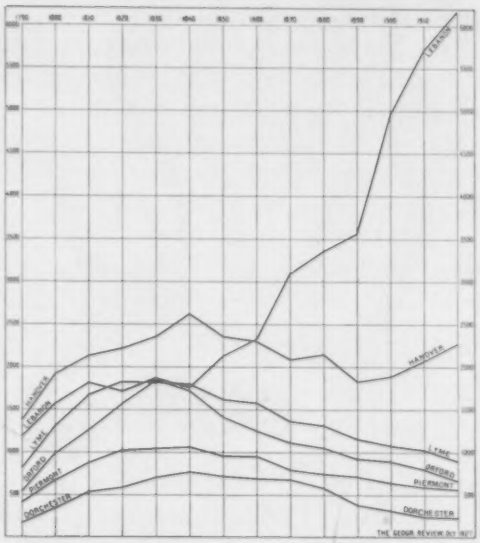


FIG. 17—Graph showing population of Lyme, N. H., and neighboring towns from 1790 to 1920. Compare Figure 16.

The latest aspects of the influence of the recreation movement have been the development of overnight stopping places for automobile tourists, the multiplication of small service stations and refreshment stands along all motor routes, and the selling of vegetables, apples, and other home products at thousands of wayside counters. This business is great in total amount but very widely distributed among the native farming population. It is significant also that summer residents are coming earlier and staying later in the season than formerly; and that efforts of hotel men, railway men, and local merchants to induce people to come up into New Hampshire for mid-winter vacations or holidays are meeting with encouraging response.

FLOOD AND EBB IN THE MIDDLE CONNECTICUT VALLEY

Before looking closely at the town of Lyme we may glance at the block of townships among which Lyme has a central position. The influences reviewed in the foregoing paragraphs have called out differing responses from them, for reasons that will be rather obvious. The map, Figure 16, shows a group of seven towns, namely Hanover, Lyme, Orford, and Piermont along the Connecticut River,

and Canaan, Dorchester, and Wentworth adjoining the first four along their eastern borders. These towns were all chartered and settled during the period between 1760 and 1770, with those on the river first to be occupied. On the population curves (Fig. 17) we find Lyme and Orford rising rapidly to a maximum of 1800 population about 1830, then losing strength steadily to 1920, when the population is less than 50 per cent of its old maximum of ninety years ago. Dorchester, high up on the watershed between the Connecticut and Merrimack, has always been a poor town, although, in spite of its handicaps, it was pretty well cleared and farmed by 1840. Since then its population has fallen to 30 per cent of the old figure, and three-quarters of its area has grown up to woodland and forest and contains not a single occupied house. Hunters, fishermen, and campers find here a paradise of deserted roads, overgrown pastures, ruins of old farm buildings, along with plenty of game. Partridges and foxes are more numerous than human beings. Piermont, next township "up-river" from Orford, reached its peak also in 1840, with about 1000 inhabitants and no industry save farming. Its decline has been somewhat less rapid but none the less sure than the others.

The two towns that lie southeast present a marked contrast. Hanover, since its settlement in 1761 the seat of Dartmouth College, shows the usual wave curve of the rural New Hampshire town, with maximum at 2163 in 1840, and steady decline to 1817 in 1890. During all that time the college was small and the township was almost wholly agricultural. Between 1890 and 1900 the rebirth of the college, under a distinguished educator, gave the town new life; and it has risen steadily again to something like its population in the days of profitable agriculture. Even now the land under cultivation (chiefly as dairy farms) reaches farther up the hillsides here than it does in adjoining townships; but the area farmed is only a small part of what was farmed in 1840. The population has gravitated toward the college in the southwestern corner of the town, where it is packed closely into a village precinct.

Lebanon, which lies next southwest of Hanover, on the Connecticut and Mascoma Rivers, has topography and soil as favorable for farming as the surrounding towns, but is far more favorably situated than they for manufacturing. Several really good power sites on the Mascoma River were occupied early, and others have been taken up by manufacturing and power companies. With the coming of the railway in 1847 the town began to gain rapidly and now it is three times the size of its neighbors. Immigration of French Canadians to work in the factories has been considerable; but there has also been a strong draining of the native-born from the farms of the township and those around it. No town in the state, perhaps, offers so good a chance to study in detail the shift from farm to factory.

Lyme: The Township and Its Activities

Like many New Hampshire townships, Lyme is rhomboidal in form and measures six or seven miles on each side. Although in detail its surface is irregular, the broader features are simple and orderly. From the flood lands of the Connecticut River, on its western border, and the somewhat higher terrace of silt that represents the floor of an old glacial lake the upland rises eastward and southeastward over successive ridges and highland areas into a really rugged eastern frontier. Here, at the northeastern corner of the township, Smart's Mountain rises domelike over 3000 feet. To the south, lower hills, yet also fairly rugged and exceeding 2000 feet, break a wooded sky line.

The northeast-southwest trend of the folded metamorphic rocks that pass beneath this township gives to its worn-down surface a strong grain, with ridges and swales parallel to the master feature—the valley of the Connecticut River. But the three streams that drain this township into the Connecticut cross the structure and the ridges squarely, from southeast to northwest. Typical of glaciated New England, these brooks descend by a bewildering series of short rapids, cascades, and still-water stretches, twisting and straightening out as they struggle over ledges or escape around them by cutting through the stony mantle of drift. Midway along the valley of the central stream, Grant's Brook, in the geographic center of the township is the little village of Lyme Center (first called Cook City and then East Lyme), which consists of about twenty houses, a Baptist church, a schoolhouse, a sawmill, and a small but very "general" store. The local post office, as in many a small New England neighborhood, survives in a private house. Two miles down the road, where this valley reaches the upper terrace plains of the Connecticut, is the larger village of Lyme Plain. Two or three stores, a schoolhouse, a large white church of the colonial period, a prosperous village hotel, and a typical old burying ground that looks much too large for the place give distinction to the sides and corners of the village common and indicate that this is certainly the life center of a township.

In the days of its settlement Lyme was reached from the south by road up the Connecticut River, which was passable at least for oxcarts and horseback riders. This old "river road" has never been "thrown up" by the town, but it is so distinctly off the course of modern travel that one may follow it for miles without having to turn out for an automobile. The tourist highway, or "Dartmouth College Road," lies a mile farther in from the river, climbing across low hills from Hanover to Lyme Plain and then descending to the level clay lands of the river valley. This western half of the township is well covered with town roads, in all stages of upkeep or disuse. The eastern half, however, has almost entirely been given over to nature. The road that leads eastward from Lyme Center toward Dorchester is the only

FIG. 18

FIG. 19

FIG. 20

FIG. 18—Cellar hole on Dorchester road near Smart's Mountain.

FIG. 19—Old cellar hole near Hardscrabble.

FIG. 20—Cellar hole in a clearing near Smart's Mountain. Birches have grown up out of it. Old apple tree back of plane table.

traveled road in the area and links loosely together a few small farms, which terminate halfway to the Dorchester line.

While Lyme looks like a rich field in which to study at close range the story of decline of population, there is one serious handicap. All the town records prior to 1873 were destroyed by fire, and it boasts no published contemporary early history. The most interesting and informing account available, by far, is an historical sketch of some thirty-five pages written in 1886 by P. H. A. Claflin, a native of the town, for Child's Gazetteer of Grafton County.[11] This draws richly from the memories of old persons then living, from family Bibles, and from other memoranda. The books of the Selectmen and Tax Assessors since 1873 contain interesting material touching area under cultivation, sheep raising, stock farming, poultry raising, dairying, lumber cutting, etc., and show how rich in interest the books of the earlier periods would be if they were available. But records of the late seventies and eighties after all do little more than corroborate

[11] Hamilton Child: Gazetteer of Grafton County, N. H., 1709-1886. Syracuse, N. Y., 1886. Section on Town of Lyme by P. H. A. Claflin, pp. 517-551.

and make more exact the knowledge that one may get from conversation with well preserved octogenarians of today. Records of the local church, which ranked among the largest of the state for many years are of more interest to the antiquarian than the geographer. A complete study of wills and deeds recorded (at Woodsville, N. H.) by early inhabitants of the township would probably supply much information not elsewhere obtainable; but that has not been attempted.

FIG. 21—The old church at Lyme plain.

Mill wheels have turned at fifteen or twenty points on brooks in the township. There is no power site here on the Connecticut River. Lumber, shingles, bobbins, flour, corn meal, and cider seem to have been the chief products, and although one or two of these mills survive to the present day their influence has never gone much beyond the town line. No industry of special interest has ever sprung up in Lyme to distinguish it from its neighbors. Orford, for example, was a producer of soapstone from 1800 to 1835, which was widely used through this country for gravestones, box stoves, mantelpieces, and chimney connections. As late as 1870 we find the "manufactories" in Lyme numbered as 23, with a total number of but 53 "hands employed." Five of these were lumber mills, which employed a total of 20 hands; one was a gristmill with a single "hand"; one a tannery with two "hands"; and one a small starch factory. There was never a cotton or woolen mill in town. From scattered information one is led to think that the "manufactories" of Lyme in the seventies (when Manchester was forging ahead in this field) were cider mills, blacksmith and harnessmakers' shops, a stonecutter's establishment, a tin shop or two, and a milliner's shop.

In the mercantile business and trades these New Hampshire villages show odd division and combination of technique, especially

from 1860 to 1890, when specialization was rife yet decline in population put into the hands of a few of the more ambitious and prosperous survivors the diminishing business or trades of many individuals.

Chiefly on account of the absence of factories in Lyme and adjoining towns, there has been hardly any incoming of French Canadians or others of foreign birth. The old New England stock survives, almost unaccompanied. This makes the picture of the decline simpler and clearer than in most New Hampshire towns. In the southern part of the state, especially, foreign-born workers in mills after several years of careful saving of their earnings have purchased deserted farms and are occupying and developing them successfully.

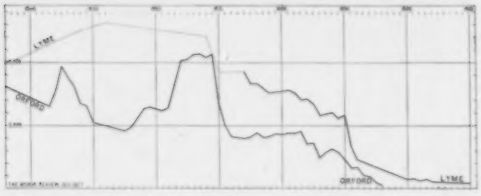


FIG. 22—Graph showing the number of sheep in Lyme and Orford townships from 1836 to 1910.

It is unfortunate that we cannot get exact information as to the extent of land actually under cultivation in the period of greatest occupation (1820–1840) and of the changes in choice of crops and uses of farm land in that early period. From Belknap and others we learn that Indian corn and wheat were regarded, at first, as the leading crops of the state, corn averaging over 40 bushels to the acre and wheat 20 to 50 bushels according to the character of the soil. The intervale lands of the Connecticut valley, such as those along the western side of Lyme, produced the richest crops. Winter rye was thought to be the best crop for newly cleared land. Barley, flax, oats, and peas were raised on land that had been several years under cultivation. Potatoes, averaging 200 to 300 bushels to the acre, were grown everywhere; and in several towns there were large starch mills. Pork, beef, mutton, butter, cheese, and poultry were produced in quantity.

The westward emigration of farmers was reflected in a westward movement of wheatfield and cornfield areas, and by 1845 or 1850 the stony hillsides of Grafton County had largely become sheep pastures. The passing of the era of homespun clothing and the coming in of improved machinery, with growth of mills in southern New England, in the 1830's, created a demand for wool which found ready response here. The number of sheep in the town of Lyme in 1836 was 9867[12] and had increased to 12,557 in 1848 and 13,176 in 1855.[13] Lyme, Hanover, Lebanon, and Walpole were the largest sheep-raising towns in New Hampshire for several decades, but neighboring townships on both sides of the Connecticut River were close competitors, and

[12] C. Benton and S. F. Barry: A Statistical View of the Number of Sheep in the Several Towns and Counties in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, and Ohio . . . in 1836 . . . Cambridge, Mass., 1837.

[13] E. A. Charlton: New Hampshire As It Is, Claremont, N. H., 1855, p. 277.

the Vermont towns as a rule were slightly in the lead. Although the fortunes of the sheep farmer rose and fell irregularly during and after the Civil War, sheep raising continued to be the chief occupation in Lyme until 1890, with the total number, up to 1886, never falling much below 6000 (see Fig. 22). Pride was felt in raising pure Merino stock. Out of 74 "live stock breeders and dealers" in the "Classified Business Directory" in Child's Gazetteer[14] in 1886, 68 farms advertise sheep and only six stock farms specify cattle or swine in addition to sheep.

One credits the traditions and statistics of this vanished sheep industry when he explores the wilderness around Holt's Ledge and Smart's Mountain and finds not only in shrub-covered pasture but even in full-grown pine forest the high stone walls and enclosures and the rudely outlined foundations of sheep barns and sheds. Today there are hardly 150 sheep in the whole township, or scarcely more than one per cent of the old number. In spite of the fact that a recent Bulletin of the U. S. Department of Agriculture[15] has called attention to the practicability of reviving the sheep industry in the New England upland, no one in Lyme seems able or willing to try it. The killing of sheep by dogs, trouble from diseases, and the cost of renewing pasture fences—by sheep wire in place of field stone and rails—are the reasons usually given.

The Four Maps of Lyme: 1830, 1860, 1892, 1925

The earliest known map of Lyme township showing houses is that of Woodford in 1855.[16] This forms the basis for the plotting of houses on the first map of our series (Pl. IV); but there have been added to it about twenty house sites of earlier date revealed by field work in 1925. For want of better information it is assumed that all houses standing in 1855 were also standing as early as 1830 (when the population was at its maximum) and also that all cellar holes of date prior to 1855 mark sites of houses standing in 1830. While neither assumption can be strictly true, we have in them the only practical means of mapping the approximate condition of things in 1830. Further search over the forested tracts in the eastern part of the township will doubtless disclose a number of other cellar holes of this early period; for even the oldest of them are not badly blurred by time but are merely hidden by bushes and trees.

Although the rugged eastern half of the township even in 1830 was less fully occupied than the western half, nevertheless, roads ran

[14] *Op. cit.*, pp. 341–342.

[15] D. A. Spencer and others: The Sheep Industry, *Yearbook U. S. Dept. of Agric. for 1923*, pp. 229–310.

[16] Map of the town of Lyme, Grafton County; from actual survey by W. C. Eaton. Published by E. M. Woodford . . . Philadelphia, 1855. Scale, 100 rods to an inch.

out across it in all directions and climbed far up the slopes of Smart's Mountain and the hills west and south of it. The "Quinttown road" ran diagonally up the southwest spur of Smart's Mountain to the 1700-foot contour and thence northward two miles more beyond "Hardscrabble," passing through a rocky saddle among the hills and down into the township of Orford where, in a remote corner, was

FIG. 23—A handful of sheep where thousands used to graze.

the then flourishing village of Quinttown. Here were about fifteen houses, a few sawmills, shops, a schoolhouse or two, and a store; and there was a schoolhouse (gone before 1855) at the top of the long hill on the mountain side, with 50 or 60 pupils. From 1820 or 1830 down to 1878 limestone was quarried on the mountain side and burned for plaster in a small limekiln on the farm half a mile north of this schoolhouse—a rare industry in New Hampshire.

From the old Dorchester road several branch roads, bordered as a rule by stone walls, ran up to farms on both Smart's Mountain and Gline's Hill, where now the cellars and orchards of the pre-1855 period are found well above the 1500-foot contour and over a mile from the main road. The exact upper limit of this early settlement can only be guessed by means of stone walls, pastures cleared of field stone, and occasional apple trees. A few of the locations shown on the map are approximate.

The southeast corner of the township was traversed by the Grafton Turnpike, chartered in 1804, over which a stage made regular trips from Orford through Lyme Center to Canaan and Andover as late as 1847. There were probably more houses on it in 1830 than we have located. At least one road extended eastward from the turnpike into the wooded wilderness south of Gline's Hill, where there was a small

settlement still referred to as Tinkhamtown. Two cellar holes have been located here; and somewhere in the woods beyond them there is a "lost" graveyard. It may be that a road once passed all the way over the ridge east of Tinkhamtown into the township of Dorchester.

The rugged pair of hills west of the turnpike, called Bear Hill and Holt's Ledge where cliffs of granite and schist are enveloped in

FIG. 24—A corner of the deserted cemetery on the road to Dorchester.

rocky slopes, had their farms also. A road ran up over the high saddle between them. Its north and south ends are still marked by cellar holes and walls; but the course across the saddle itself cannot be traced.

A crooked road with heavy grades swung around the south side of the Bear Hill mass below the 1400-foot contour, on which there were several farms. One of these houses was occupied until 1924, although the road was among the first to fall into disuse.

The western half of the township, though not without uncultivated tracts of highland, was more uniformly occupied. In this region the northeast-southwest system of roads fitted more obediently the grain of rock structure and topography. In the region of Plott Hill, for instance, were four parallel roads about a half mile apart. All were well occupied, although two of them followed valleys, one lay along a sidehill, and the fourth followed the crest line of the bleak ridge of Plott Hill for nearly two miles at an altitude of over 1000 feet. A continuation of this Plott Hill road, a mile or two to the northeast along the western slope of Acorn Hill, was in use in colonial times but was probably abandoned before 1830 and is therefore not shown on the map.

The second map of the series is based upon the one by Walling.[17]

[17] See footnote 2.

In most respects it agrees in detail with the earlier one by Woodford but is much more accurate as regards directions and distances. It appears that before 1860 at least twenty-eight houses had been abandoned—the number is probably much larger. Twenty-three of these are in the eastern half of the township at an average altitude of more than 1400 feet and all but one above 1100 feet. Of the 321 occupied

FIG. 25—Down the old Quinttown road toward Holt's Ledge.

houses in the town of Lyme in 1860 sixty (or approximately 20 per cent) were in the eastern half of the town. In this section at least six miles of road had been abandoned by 1860.

The Smart's Mountain-Gline's Hill gap had lost heavily in population, although two or three branch roads still served in 1860 and for five or ten years longer. One new house, indeed, had been added close to the Dorchester line on a low spur of Smart's Mountain; but three houses had been abandoned in that immediate vicinity. A noteworthy record of the outgoing tide from this neighborhood is found in the little graveyard beside the Dorchester road just west of the height of land, where 10 out of 14 of the family names that apear on the 35 headstones are not found among the families living in this district in 1860. They record deaths between 1810 and 1852. In those days of many children, the vanishing of a family name from a community means emigration. Here on the side of Smart's Mountain the tide was ebbing fast by 1860.

The condition of Lyme township in 1892 has been taken from the map in Hurd's Atlas.[18] By that time the Quinttown road had been abandoned, as had also the village at its north end in the next township. The entire northeastern quarter of the township, so largely occupied by Smart's Mountain, thus became a blank on the population map. Up the Dorchester road, east of Lyme Center, all branches

[18] See footnote 3.

of the road system had withered away on the slopes of Smart's Mountain and Gline's Hill; and along the main stem there were left occupied a bare half-dozen houses on a three-mile stretch, with one little schoolhouse and the old graveyard. Location on this old highway had lost its advantage; for by this time the adjoining township of Dorchester had become almost wholly deserted, and no one used this road except these inhabitants of Lyme themselves.

On the turnpike every house had been deserted by 1892, but the road, still kept up, served as a line of communication for a single family who lived on the hill road that ran from the turnpike toward Bear Hill. The rest of this road had been discontinued, two houses on it finding communication southward by steep downhill roads toward Toad Hollow, which was still a real neighborhood. Farther west, Plott Hill had been wholly deserted, although the road along its crest still shows on the 1892 map.

Eight miles of road were given up between 1860 and 1892. Forty-five houses were abandoned. Of these, 19 were in the eastern half of Lyme. In other words, out of 60 occupied houses in this eastern half in 1860, one third were deserted by 1892.

The loss both in houses and in miles of road during the final 30-year period (1892–1925) has been as heavy as during the preceding one. Fifty-nine more houses have become unoccupied. Of these, 22 were in the eastern half of the township; and there are only 24 left. More than 12 miles of road have been given up or at least allowed to become unsafe.

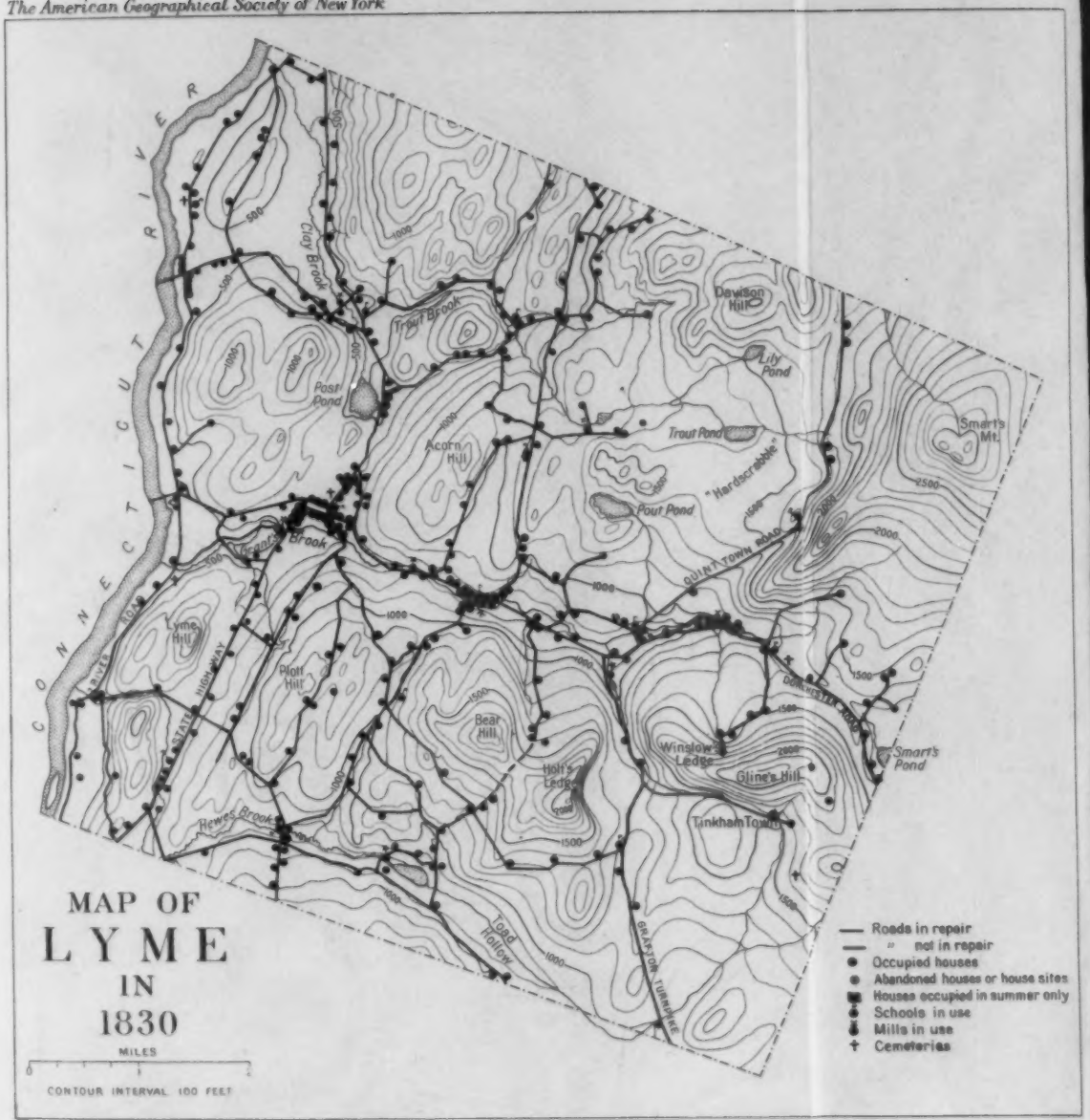
The Dorchester road is still kept in repair and is traveled over from May till November; but it is used in winter only for hauling out pulpwood and cordwood. Five houses on this road that were occupied in 1892 are gone or in ruins. The last occupied house on the road (which was built after 1860) is only halfway out from Lyme Center to the town line. Beyond it on the Dorchester road and its old tributaries are the sites of at least twenty-two former houses. The tide of humanity has drawn down to the 1100-foot contour, leaving the old graveyard in a silent wilderness.

The Quinttown road, long ago become impassable, makes a good trail for the Dartmouth Outing Club. It is nearly five miles from the last occupied house in Lyme to the first one in Orford. The old Grafton Turnpike is in an uncertain state of repair. At the time of our survey, in 1925, parts of it were scarcely passable. From time to time, however, a lumber company gets busy or money is appropriated by town or state to "bush out" the road, fill up the gullies, and mend the culverts; and despite the fact that there is no occupied house on it for several miles through Lyme, Hanover, and Canaan, it may still be saved as a traveled road instead of becoming permanently disused. Its branch, the "Old Tyler Road," is entirely abandoned, the last

house on it becoming vacated in 1925. The road over Plott Hill and the crossroad at its north end have been officially closed by the town. But it is in the Acorn Hill neighborhood that the most striking change has come. Here several families have moved away from as many houses during the last few years, and the little schoolhouse is closed. One family only remained in this neighborhood in 1925 on the most remote farm of all, three-quarters of a mile up Trout Brook, one of eight houses still occupied in the township above the 1100-foot contour out of 69 once occupied at that altitude. Not one of the eight houses stands at more than 1150 feet. The 1100-foot contour, therefor, marks a rather definite population strand line for 1925.

So the town is still moving downhill. When will it stop? Where will recovery of strength begin? What social and economic factors will bring it about? And if the tide of population sets in again here, as it has already begun to do in more favored parts of the state, will it rise uniformly across the contours, or will it no longer obey the simple influence of slopes and altitudes?

The American Geographical Society of New York



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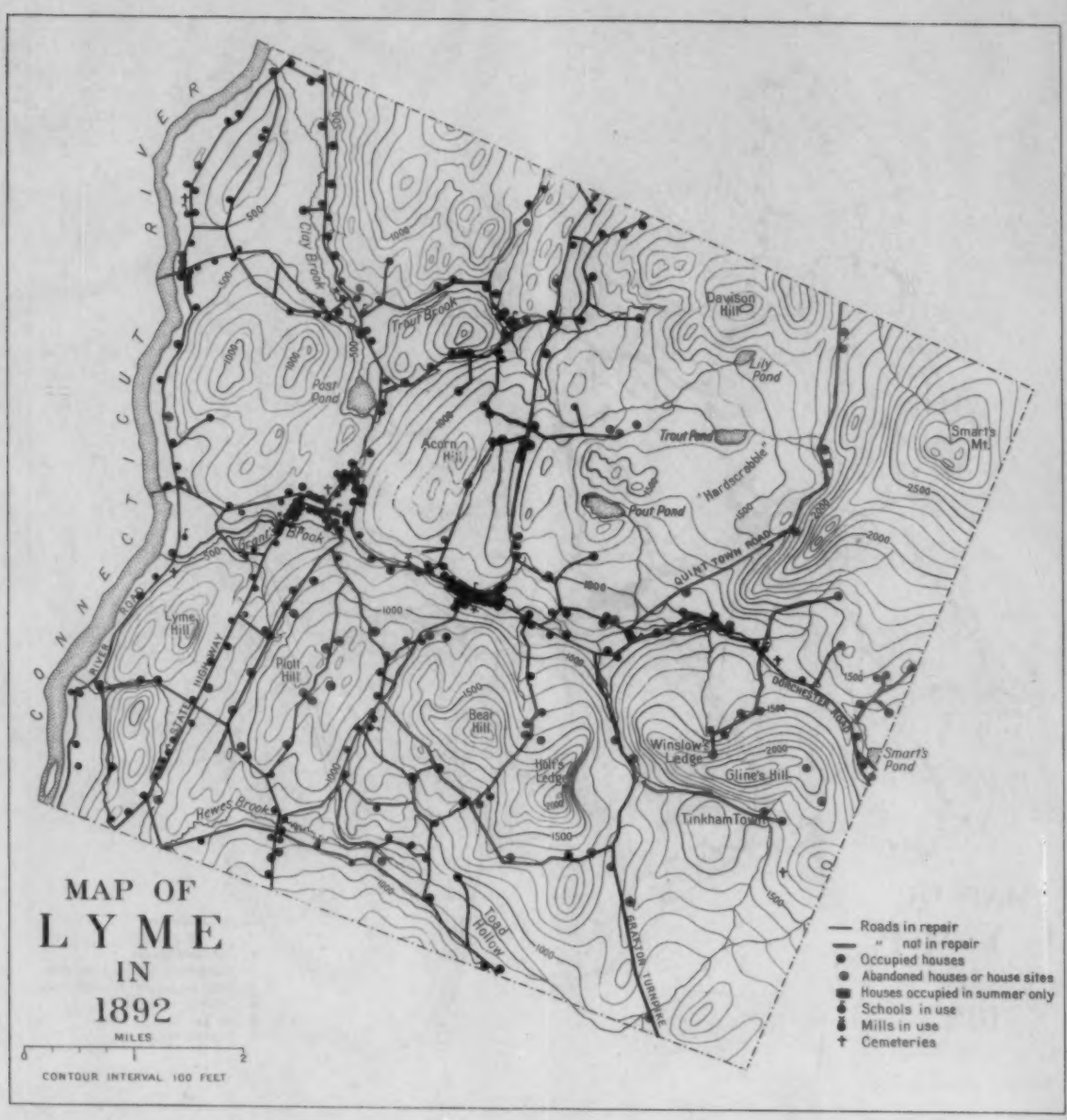
CONNECTICUT RIVER
Clay Brook
Trout Brook
Post Pond
Acorn Hill
Davison Hill
Lily Pond
Trout Pond
"Hardscrabble"
Pout Pond
Smart's Mt.
QUINT TOWN ROAD
DORCHESTER ROAD
Smart's Pond
Winslow's Ledge
Gline's Hill
Tunkham Town
Lyme Hill
Ploff Hill
Bear Hill
Holt's Ledge
Hewes Brook
Toad Hollow
GRAFTON TURNPIKE
MAP OF
LYME
IN
1860
MILES
CONTOUR INTERVAL 100 FEET
Roads in repair
not in repair
Occupied houses
Abandoned houses or house sites
Houses occupied in summer only
Schools in use
Mills in use
Cemeteries


CONNECTICUT RIVER
Clay Brook
Trout Brook
Post Pond
Acorn Hill
Davison Hill
Lily Pond
Trout Pond
"Hardscrabble"
Pout Pond
Smart's Mt.
2500
2000
QUINTY TOWN ROAD
Lyme Hill
Pliott Hill
Bear Hill
Holt's Ledge
Winslow's Ledge
Gline's Hill
Smart's Pond
Tinkham Town
Hewes Brook
Toad Hollow
BEATON TURNPIKE
MAP OF
LYME
IN
1892
MILES
0
1
2
CONTOUR INTERVAL 100 FEET
Roads in repair
" not in repair
Occupied houses
Abandoned houses or house sites
Houses occupied in summer only
Schools in use
Mills in use
Cemeteries

CONNECTICUT RIVER
Clay Brook
Trout Brook
Post Pond
Acorn Hill
LYME PLAIN
Dawson Hill
Lily Pond
Trout Pond
"Hardscrabble"
Pout Pond
Smart's Mt.
QUINT TOWN ROAD
LYME CENTER
Lyme Hill
Plum Hill
Bear Hill
Holt's Ledge
Winslow Ledge
Gline's Hill
Linkham Town
Smart's Pond
DORCHESTER ROAD
Rewes Brook
Toad Hollow
GRAFTON TURNPIKE
MAP OF
LYME
IN
1925
MILES
CONTOUR INTERVAL 100 FEET
Roads in repair
not in repair
Occupied houses
Abandoned houses or house sites
Houses occupied in summer only
Schools in use
Mills in use
Cemeteries

THE RIO LOA OF NORTHERN CHILE

William E. Rudolph

IN the northern part of Chile, between Arica and the mouth of the Rio Copiapó, there is a stretch of 600 miles of coast line in which only one river reaches the ocean throughout the year. It would be difficult to imagine a place more desolate than this portion of the Atacama Desert—a wind-swept surface, sunburned and sterile, broken here and there by the grimy white of the salars. Through it twines the hidden green canyon of the Loa. Both in itself and in its bearings on man's occupation of the region the Loa is of exceptional interest. On the one hand are the oases of today and the numerous remains of a pre-Spanish civilization; on the other the fact that Chile's longest river in its 252-mile course traverses a country of greatly varied and in many parts unique physiography.

Settlement in the Loa Basin

The Atacama Desert is indeed one of the most barren surfaces of the earth. Travelers report journeying for days over its pampas without seeing a sign of vegetation. Plant life, however, does exist. Occasionally, in even the most barren waste, one finds a green bush with a small yellow flower; at the most dismal point in an endless white salar appears a tuft of dried grass. A little water hole amid the waste is often marked by a considerable number of species. During a visit to the La Teca spring, on the cattle trail between San Pedro de Atacama and Calama, in the late autumn I found eleven varieties of tola bush and other plants and two varieties of cactus. There are only two types of surface in the entire basin at which I have failed to find some form of vegetation at some period of the year: one at certain salars whose chemical composition makes life impossible—a notable instance is found in parts of the white pampa surrounding the Ojos de San Pedro, where the surface salts contain 45 parts per million of free sulphuric acid—, the other far above the normal snow line.

Many of the plants have a special interest to natives and explorers as denoting the presence of ground water, its depth, volume, and salinity. San Roman[1] mentions a number of these including the tolas; *cuernecilla*, or goat's-horn; jume (*Lycium*); *brea;* and *cachiyuyos* (*Atriplex*), which derives its name from the Quechua "cache," salt, because of the brackish water it indicates. The grass *Chépica* (*Pas-*

[1] F. J. San Roman: Desiertos i Cordilleras de Atacama (3 vols., Santiago, 1896), Vol. 3, p. 217.

FIG. 1—In the upper basin of the Loa. The volcano San Pablo (5890 m.) and the Rio San Pedro.

FIG. 1—In the upper basin of the Loa. The volcano San Pablo (5890 m.) and the Rio San Pedro.

FIG. 2—On the coast near the mouth of the Loa. Note the characteristic afternoon cloud, or *camanchaca*, on the slopes of the Coast Range.

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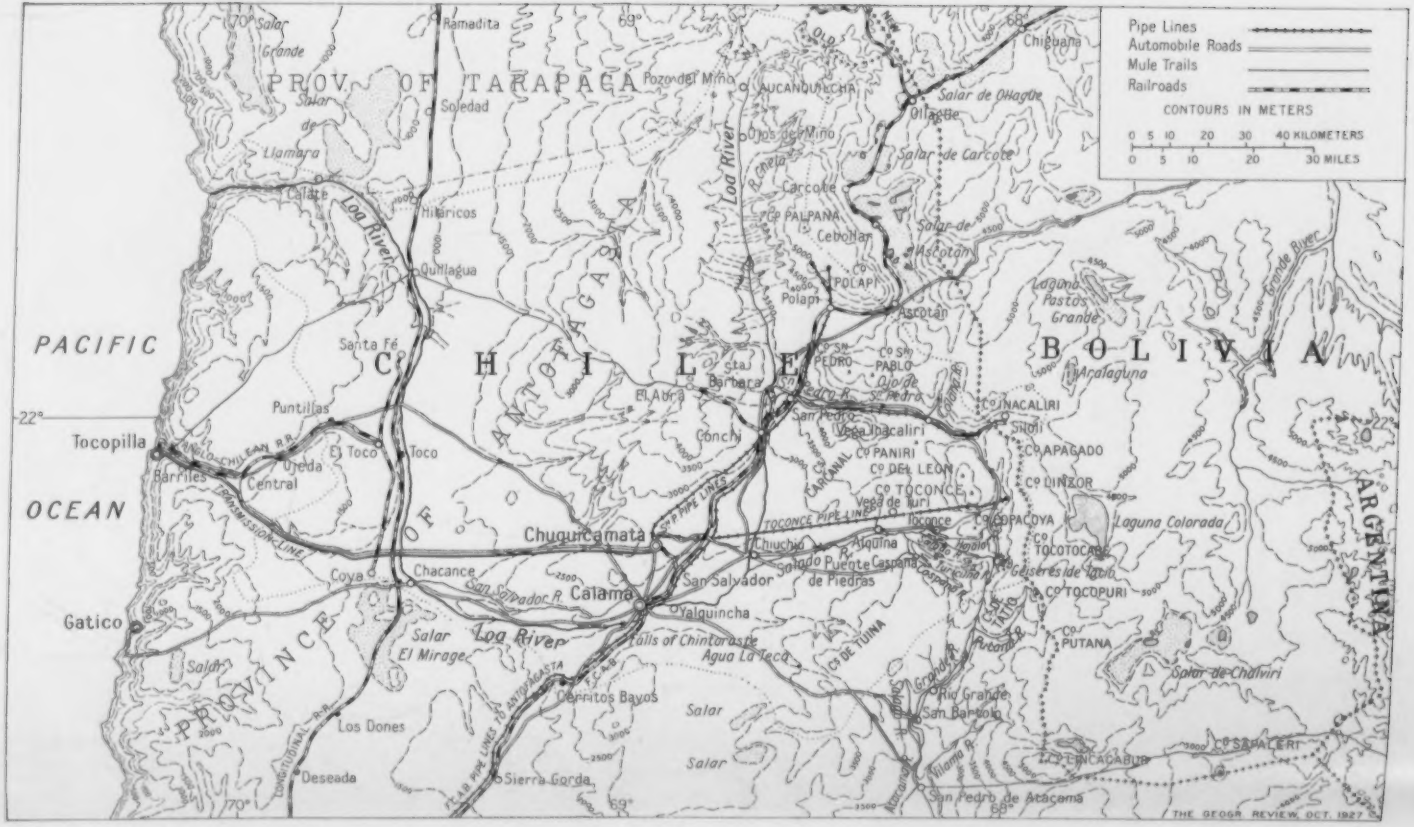

FIG. 3—Map of the Rio Loa basin drawn from the American Geographical Society's Millionth Map of Hispanic America, Iquique sheet, and reduced to approximately 1:2,000,000. The watershed of the basin is indicated by a line of fine dots.

palum vaginatum) of the coast indicates potable water while the *Chépica brava* (*Distichlis thalassica*) of the Cordillera indicates water salty but fit for animals. But plant life is no more than a rarity save in the regions where summer showers occur.

Naturally such a country is repellent to human settlement, but it has an offset in its mineral wealth. The 10,000 square miles of the drainage basin contain a very considerable proportion of the revenue-producing wealth of Chile, including the world's largest proved body of copper ore (at Chuquicamata) and numerous nitrate deposits. The industries to which these give rise account for the greater number of the inhabitants of the basin.

The population of the nitrate oficinas is directly dependent upon the industry itself. European synthetic fertilizers have competed so successfully with the Chilean nitrate that most of the plants treating lower grade *caliche* have lately ceased operation, and the greater part of the population has been returned to the southern and central zones of the country. Previously there were 40,000 people in the sixteen oficinas in the Loa basin; now there are scarcely one-eighth that number.[2]

While the nitrate industry is only sixty years old, mining dates back to ancient times. Today copper minerals are by far the most important ores mined in the region. The mining has been for the most part carried on upon a small scale and has been subject to the state of the market. With downward trend of the price of copper since the World War and the concomitant increase of wages, many of the smaller mines have not been producing for some years. The plant at Chuquicamata is the largest single industrial enterprise in Chile, employing 8000 workmen, who, with their families, constitute a population of 18,000 souls. About nine-tenths are Chileans, and the rest are mainly North Americans.

Practically all the permanent population of the Loa basin is grouped in six agricultural communities watered by the Loa and its tributaries: Calama, with about 1200 inhabitants; Chiuchiu and environs, 500; Quillagua, 300; Caspana, 60; Aiquina and the Vega of Turi, 160; and Toconce, 70. Calama is an old Bolivian town which, although it has become an important division point of the railroad, remains essentially Bolivian as to manners and customs. The houses are mostly of adobe, with corrugated iron roofs. The greater part of the population are Cholos, Indians with some Spanish blood. As with most primitive peoples, the women tend the farms and pastures. Most of the trading is in the hands of Jugoslavs, Spaniards, and Syrians.

There are no sewers, and sanitary facilities are entirely lacking in most cases. Water, however, has been piped by the railroad com-

[2] At this writing, late April, 1927, a number of these oficinas were preparing to resume operation.

FIG. 3.—Map of the Rio Loa basin drawn from the American Geographical Society's Millionth Map of Hispanic America, Iquique sheet, and reduced to approximately 1:2,000,000. The watershed of the basin is indicated by a line of fine dots.

pany to a number of hydrants about the village. Calama also has a good electric light service, based upon water power from the Rio Loa. The farm products of Calama are principally alfalfa and corn. Sheep and llamas are raised on the *vega* (meadows), providing meat and wool. Cattle from Argentina are pastured here before being shipped to the nitrate centers. In recent years there have been established a black powder and a dynamite plant, which are shipping explosives to the mines of Bolivia as well as to the nitrate fields of Chile.

Chiuchiu is an old Indian settlement, now four-fifths in ruins. There are indications that the area within which it is situated, extending from the Loa-Salado confluence to the end of the wide canyon floor twelve miles to the north, was a populous center of an older civilization before the Conquest. It was destroyed by the Spaniards during the sixteenth century. The old pueblo in the canyon has remained in ruins since.[3] Chiuchiu of the present day is situated on the *vega*. The town was partly reduced to ruins by an earthquake on May 9, 1877, and completely so by another on January 23, 1878.[4] The alfalfa crops of Chiuchiu are more than double those of Calama per acre irrigated.

Cultivation at Quillagua dates back for centuries. An ambitious scheme for better irrigation came to naught when the earthquake of 1878 partially destroyed the canals. That farming can be conducted there is surprising, considering the high salt content of the water. Lower altitude and a moderate climate are in its favor, there being no green area in the entire basin subjected less to extremes of cold.

Caspana, Aiquina, and Toconce have already been written of as the out-of-the-world villages of the Loa.[5] The cultivated plots at these little towns are arranged in a series of terraces, all available surface being used, including narrow berms at the sides of vertical cliffs. Only at Toconce is water plentiful. Caspana removes the entire flow of its river during the irrigating season. Aiquina depends upon springs, for the waters of the Salado are brackish. Dwellings of adobe with straw roofs and cactus-wood doors, churches with copper bells, and the inevitable cross upon the cliff or hill overlooking the pueblo are characteristic of all three of the villages.

No great cultural changes have occurred among the people inhabiting the Loa basin since the advent of the Spanish conquerors, their customs having survived far better than their numbers. They present an interesting problem for archeologist and anthropologist. Relics of these people are still to be found in the older cemeteries, but

[3] See an anonymous article, "El mineral de Chuquicamata," *Ingeniería Internacl.*, Vol. 7, 1922, pp. 295–300. New York.

[4] San Roman, *op. cit.*, Vol. 3, p. 391.

[5] Earl Hanson: Out-of-the-World Villages of Atacama, *Geogr. Rev.*, Vol. 16, 1926, pp. 365–377.

FIG. 4

FIG. 5

FIG. 6

FIG. 4—Chiuchiu, a green spot in the desert. See also Figures 7 and 21.
FIG. 5—Shelter of present-day Changos near mouth of the Loa.
FIG. 6—Terraces and stone walls dating back to the earlier Changos at the water hole of Mamilla, about eight miles north of Tocopilla.

not for long. Mining enterprises have brought a host of curio seekers from other countries, and incentive has thus been lent to the more daring natives to dig up the buried trinkets. At this writing but little remains undisturbed of the burial grounds of Chiuchiu. Skulls have been scattered promiscuously over the ground or arranged as subjects for the amateur photographer.

FIG. 7—The fortress in the canyon above Chiuchiu. A portion of the old irrigation canal appears in the foreground at the left of the trail.

THE CHANGOS OF THE COAST

The earliest inhabitants of the Loa valleys were probably the Atacamas, or Atacameños, a race which came from the east. Prior to their arrival perhaps only the coast had been peopled by fishing tribes, the Changos, whose development seems to have been more or less upon a level with the Old World peoples of the Paleolithic age. These people must have existed upon fish as a main diet, although there are evidences that they also cultivated the land upon a small scale. Where the Loa emerges from its canyon about a mile from the sea, there are remains of terraces and algarrobo trees at the north side of the stream. One finds no evidences of an irrigation canal, and so it would appear as if the Changos carried river water to the farms, possibly in sealskins. Similar terraces are found at the Quebrada of Mamilla, about eight miles north of Tocopilla, where springs of potable water emerge from the cliffs far above the sea. Most of the remains of the Changos, however, are beside the beach at the northern sides of promontories. They are marked by large piles of shells, and excavations at such places have disclosed bones in sitting positions, together with cooking utensils, arms, and fishing implements. One observer has commented on the thickening of the cervical ver-

tebrae, which he ascribes to the constant stooped position which the Changos were accustomed to maintain. He has also found bones of dogs beside the bodies, leading to the belief that the Changos had domesticated this animal. They had no metals but used flint and quartz.[6] Fuel was quite plentiful, for parts of the Coast Range are covered with cactus owing to the moisture of the *camanchaca*, or

FIG. 8—Chiuchiu's principal vehicle of haulage.

afternoon cloud (Fig. 2). The stone hooks and arrowheads found in and about the graves were perhaps used in conjunction with spears of this cactus, or of the cane which grows at Mamilla.

The Changos are said to have disappeared as a race about the middle of the last century, although people who possess much of their fishing instinct if but little of their blood have replaced them in small isolated groups along the coast of the province of Antofagasta. The town folk speak of them as Changos or Chungungos, both having become terms of derision. It is said that they work tiny veins of gold in the Coast Range when the fishing is not good. The regions inhabited by them are often difficult to reach by land because of the sheer precipices and treacherous talus of the coastal escarpment and difficult to reach by sea because of the heavy surf which pounds against the abrupt coast. Of some 30 miles of coast south of the city of Antofagasta, San Roman wrote in 1896[7] that the region was inaccessible because of its steep declivities, there being no record of the return of any traveler who had ventured there. Yet these inaccessible places may be clearly seen from the decks of the west-

[6] Perhaps the Changos of the last century had learned about smelting metals from the ores so abundant in the Coast Range. There are remains of furnaces as well as masses of slag in the regions frequented by them. In the older graves, however, no metals appear to have been found.

[7] San Roman: *op. cit.*, Vol. 2, p. 392.

FIG. 9

FIG. 10

FIG. 11

FIG. 9—A sulphur mine camp above the snow line in the Loa Basin.
FIG. 10—At the Vega of Turi.
FIG. 11—On the cattle trail from the Argentine to Calama.

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FIG. 12

FIG. 13

FIG. 14

FIG. 12—A laguna of the high cordillera. Extrusions of trachyte have caused it to have both underground inlet and outlet.

FIG. 13—At the headwaters of the Hojalar, a headwater stream of the Salado.

FIG. 14—Llareta, a mosslike plant, the chief fuel of the region.

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coast steamers. Some months ago the Antofagasta press carried accounts of an airplane which had been wrecked within this region. After several unsuccessful attempts to reach it both by land and sea, two Changos volunteered their services with successful outcome.

The writer found four of these present-day Changos, three men and a woman, living at the mouth of the Loa, in April, 1927. They had built a crude shelter of burlap bags and oil cans on the south side of the river at a short distance from the surf and had installed an apparatus for distilling river water, using metal receptacles and piping removed from an abandoned gold mine. There was an irrigation ditch, with terraces for cultivation on the flat above the beach. Both were dry, however, their owners stating that the floods of 1925 had destroyed the division channel. These people had no boat. They reckoned distances in terms of days of walking, a day's journey being about twenty miles. They were accustomed to making trips to Quillagua to exchange fish and clams for tea and corn.

The Loa in Relation to Public Utilities

The waters of the Loa have had an important influence upon trade routes by supporting such supply stations as Calama and Chiuchiu. Yet neither the footpaths of Inca times, the mule trails of the later centuries, nor the railroads of today correspond with the course of the river. The oldest trail in the Atacama Desert is probably the Inca road that stretched from Cuzco through San Pedro de Atacama to the Rio Copiapó. This still remains the main artery of travel for the highland dwellers. It crosses all the eastern feeders of the Loa at right angles just west of the present Chile-Bolivia frontier, but it never approaches the Loa itself by some twenty-five miles. Other routes have been established since the Conquest, from Argentina and from the older mines to ports of the Pacific. These converge on one or the other of the settlements along the river, there to cross the stream but rarely to follow in its course. The Rio Loa meant a deep canyon to be shunned because of the difficult and often dangerous crossing which it involved.

Later came the railroads, one connecting the Bolivian altiplano with Antofagasta, a second furnishing outlet for nitrate to the port of Tocopilla, and a third stretching due north and south to form a link of the Longitudinal Railroad of Chile. Only the last follows the Loa, from Chacance to Quillagua. In the course of railroad building the Loa has been bridged at Conchi by a structure still considered the highest railroad span in the world, but now it is unsafe and no longer in use.

Pipe lines convey Loa waters to towns and industrial plants, their flow depending upon gravity in the upper and on pumping stations

FIG. 15

FIG. 16

FIG. 17

FIG. 15—Canyon of the Rio Toconce, looking toward the frontier range. Mule trail and pipe line at the left.

FIG. 16—Gate at the trail into the canyon at Caspana.

FIG. 17—Terraces on the slopes of the canyon of Rio Caspana.

in the lower sections. Steel or cast-iron pipe has been used in practically all cases. Wood-stave lines, although cheaper, are hardly practical in a region where water is so scarce and lawless citizens all too plentiful. The lines stretch across the desert for long distances, that from Toconce being 54 miles between the reservoir and the first discharge tank. The lines are laid upon the ground, as far as possible, and covered, except at joints, to protect them against the effects of the wide daily temperature ranges. They are supervised from stations about twenty miles apart by line riders, whose duties are to operate air release valves, make repairs, and patrol the line. In the event of a break, the line rider may have to depend upon mules for haulage through rugged country, but he must get the main repaired with all possible despatch, for thousands of people depend upon its supply.

Generally no charge is made for water at the industrial plants, but in Antofagasta and other towns supplied by pipe line a price of $1.40 (Chilean currency) per metric ton has been fixed. This amounts to about six and a half cents (U. S. money) a hundred gallons. The rate is more than double that charged for water in England, but this is not remarkable in view of the distance of transportation.[8] Actually, only about 25 cents a month (U. S. money) per capita is expended for water at these centers, the quantity used being restricted to from 20 per cent to 50 per cent of normal consumption of other countries, both by law and by the poverty of the people.

At the pueblos to which potable water must be hauled by rail or cart, however, the charges are much higher. Quillagua receives a car of water (about 3000 gallons) weekly, from Pintados, 75 miles north; and this is sold to the townspeople at the rate of 50 cents Chilean (6 cents U. S. currency) per five-gallon can. Despite this high price for potable water, the people do not drink the river water here because of its high content of injurious salts. At one of the stations on the railroad connecting Toco to Tocopilla, the writer paid an equal rate for water pumped from a Loa evaporating plant, this amounting to 60 cents (U. S. currency) for sufficient to water five mules.

A number of small water power concessions have been developed between Chacance and Quillagua by the nitrate companies. As a source of energy, however, the harnessing of the Loa waters has hardly begun. The initial cost of hydro-electric power installations, at about $500 per kilowatt, is too high to appear attractive in comparison with generating plants using oil. At the upper feeders of the Loa water is scarce, whereas fall is plentiful: a series of power houses using the same water again and again is therefore necessary for projects there. The Salado and its tributaries may be utilized through

[8] The pipe-line distance, Siloli to Antofagasta, is 230 miles.

a head of five thousand feet in thirty-five miles. Flows from springs even as little as one-tenth of a cubic foot per second, when at the higher elevations, represent important potential energy to the engineer and are well worth diverting into his canals. Storage reservoirs are seldom advantageous, because of excessive evaporation and constancy of stream flow.

FIG. 18

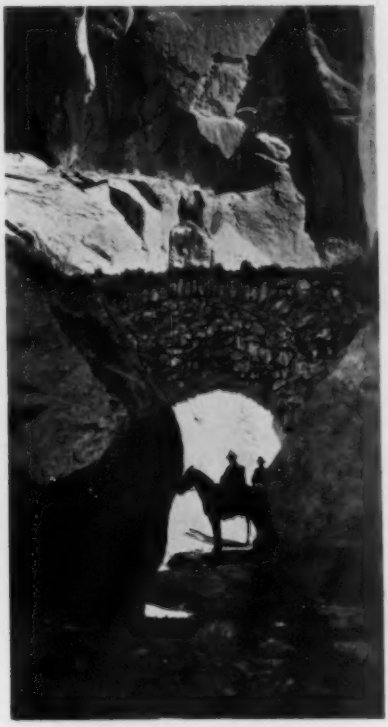

FIG. 19

FIG. 18—Puente de Piedras on the trail from Chiuchiu to Aiquina.
FIG. 19—Arch built by Indians to support irrigation canal—less than one foot wide—near pueblo of Toconce.

GOVERNMENT REGULATION OF WATER

During 1920 the Chilean Government passed laws to regulate the use of Loa waters in the interests of present and future industries. These laws state five uses for which concessions covering such waters may be granted, with preference in the order named: 1, drinking supplies for cities, oficinas, and industrial plants, and requirements for locomotives and steam boilers; 2, refining nitrate; 3, industries, including mining; 4, irrigation; 5, hydro-electric developments.

The amounts of water to be allowed individual enterprises under each of the five heads are clearly defined. Naturally, concessions of the potable waters are restricted to the first purpose.

At the present time hardly half of the surplus waters of the Loa is being used for farming. In a region where food is scarce and expensive, with industries providing an ever increasing population, this is indeed strange. But to install modern irrigation works requires money; and northern Chile is far from the seat of government, which makes such appropriations. Perhaps the recent collapse of the nitrate industry will serve to accentuate the need. Meanwhile, the Loa continues to pour treasure into the sea.

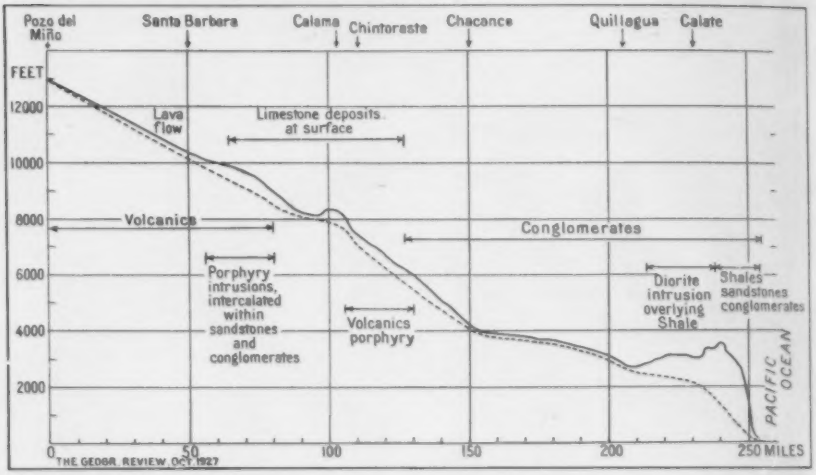

FIG. 20—Profile of the Rio Loa canyon with indications of the geology of the region. Dashed line represents the flow line, the solid line the top of the canyon walls. Vertical scale about fifty times horizontal scale.

PHYSIOGRAPHY OF THE LOA WATERSHED

The physiographic history of the Loa system goes back to Tertiary time, drainage being initiated on the then existent western slope of the Andes when they were not yet so high as to impede the passage of moisture-laden winds. Diminution of precipitation toward the close of the Tertiary, together with the advanced stage of erosion tended to level the valley floors by stream aggradation. Volcanic eruptions during the late Tertiary completed the filling of the valleys and *quebradas*, even covering the hills which marked the relief of that surface of erosion.[9] There followed subsidence with concurrent rifting and block faulting that developed both graben and broad depressed areas.[10] The portion of the Central Valley of Chile through which the Loa pursues its northward course between Chacance and Quillagua is one of these depressions. The majority

[9] Johannes Felsch: Las corrientes de agua subterranea en las zonas Central y Norte de Chile, La Riqueza Minera de Chile, June, 1926, Santiago.

[10] Robert Hawxhurst, Jr.: The Andean Salares, *Engineering and Mining Journ.*, Vol. 122, 1926, pp. 419 and 534.

of the basins are without outlet, although some slope toward *quebradas* which reach the Pacific, as at Antofagasta. Subsequent uplift[11] brought the entire mountain region to its present continuously lofty level, and with it came the arid climate. Cretaceous formations, which appear at altitudes of 13,000 to 14,000 feet bordering upon the Loa basin, show to what heights these lands have been lifted. The last page of Andean history followed, one of pronounced volcanic activity which was probably staged throughout the Pleistocene, building the mountains still higher. That the period of volcanism did not terminate before the end of the Pleistocene, or perhaps even at the beginning of the present era, is evidenced by the manner in which lava flows have obliterated glacial features throughout the region.

Over the surfaces thus formed the Loa flows, its sources among the now practically extinct volcanoes and its direction consequent upon the warped slopes. The courses of its feeders have been influenced entirely by the later lava flows, the region being interlaced with dry *quebradas* marking former drainage lines. In general, the present canyons are giants as compared with the older ones, indicating that only since the end of the volcanism have there been quiet intervals of any duration. Some of the dry *quebradas*, as exemplified at Conchi, intersect the main canyon well above floor level, as if their waters had ceased with elevation and the coming of the arid climate, whereas the through drainage channel had continued to cut deeper owing to the steeper descent. Valley widening, on the other hand, has been extremely slow since the rains ceased, with deep spectacular canyons resulting.

The Upper Loa and Its Tributaries

Whereas a large number of *quebradas* intersect the Loa above Santa Barbara, only one, the Rio Chela, carries water at all seasons of the year. The increases in volume at this section are due to seepage, mainly from the left bank.

The Rio San Pedro has its source in springs in Bolivian territory as the Rio Siloli. Its waters enter a deep canyon where, about 1500 feet east of the Chile-Bolivia frontier, is located the main intake of the Antofagasta-Bolivia Railroad at an elevation of 14,163 feet. A pipe line removes over two cubic feet per second at this point, used both for operating the railroad and as supply for the city of Antofagasta and the nitrate pampa.

Several streams join the Siloli after it crosses into Chile, drainages typical of the mountain region, flowing during the afternoon while

[11] Amounting to at least a mile, according to Isaiah Bowman: The Andes of Southern Peru, New York, 1916, p. 200.

the sun's rays are upon the snows but ceasing at night. Soon the river disappears entirely within a sand-filled lake originated by a lava flow from Panieri. Where the Rio Siloli (called Inacaliri at this place) enters, there is a marsh, but the lower portion of the area is dry. Ducks and other aquatic birds are found here in larger numbers, and stone arrowheads at the shores indicate that these are ancient haunts.

Where the Rio San Pedro reappears, at a lagoon fed by springs, the volume has been considerably increased, and the salt content also. Pipe lines leading to Chuquicamata and to Antofagasta draw

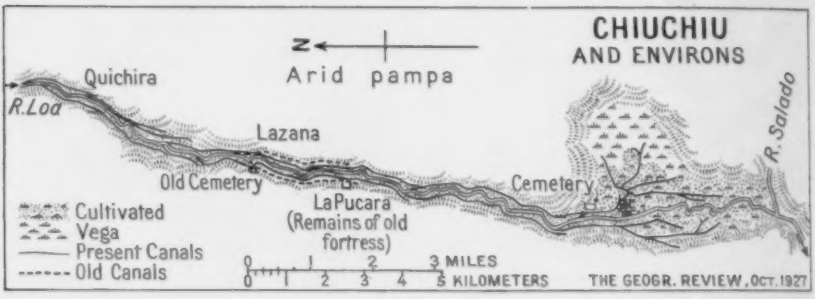

FIG. 21—The Loa valley in the neighborhood of Chiuchiu. Compare Figures 4 and 7.

off some of this flow for industrial purposes. Where the river is again diverted by lava flows to a course south of the older one, both the earlier rhyolite and the later lava flow, the one light and the other dark, show strikingly in the walls of the new canyon. The comparatively recent period of the flow is attested by pebbles of pumice which float down the river, causing no end of trouble to the caretakers of the reservoirs.

Below its confluence with the San Pedro at the small green area of Santa Barbara, the Loa is enclosed within deep narrow confines. At Quichira the *quebrada* widens and the cultivated zone of Chiuchiu begins. Thirteen canals (Fig. 21) remove water just below Quichira, having a total flow of about 80 cubic feet per second. During the irrigating season, from September to March, about 56 cubic feet per second return to the river as surface drainage and filtration. In winter the losses are far less.

The Salado joins the Loa below Chiuchiu, carrying a flow slightly greater than that left in the main stream after irrigating the farm belt. The Hojalar and the upper Salado, two of the four rivulets contributing to the Salado, are saline, increasing the salt content of the Loa to such an extent that the government once considered their diversion to evaporating basins.

The Toconce rises in a number of springs, its waters emerging at a constant temperature of 75° F. A pipe line supplying potable water to Chuquicamata has its intake at the sources, and the canal of the

village of Toconce is fed some miles below. The Rio Caspana, a mere brooklet in contrast with the spectacular canyon which it has cut through 300 feet of rhyolite, also serves a farming area.

At the head of the Salado are the geysers of Copacoya, or of the Tatio as the region is commonly known, where steam outlets, mud

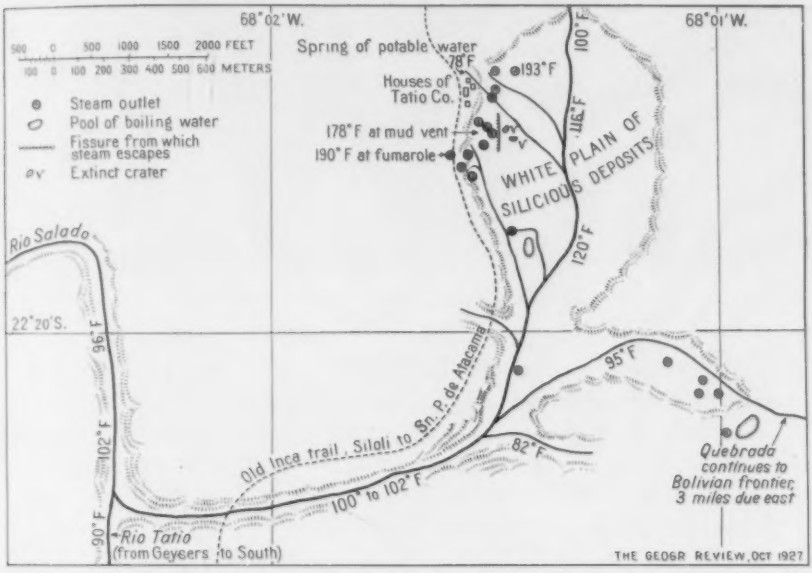

FIG. 22—The main basin of geysers at Tatio, at the head of the Rio Salado. Compare Figures 23 and 24.

vents, pools of boiling water, and mounds of geyserite appear on the site of an old crater (Fig. 22). The Indian name Tatio, applied to the hills surrounding them, means burnt, and there are indications that volcanic activities disappeared at a comparatively recent time, perhaps when the first humans began to appear in the region. At some of the boiling springs are regular intermittent explosions, whereas at others the surges are irregular. Large pools, some up to 15 feet in diameter, quietly simmer though they rarely boil. Columns of steam form a striking spectacle, particularly just before sunrise when the wind is low. Small craters, cylindrical rather than conical in shape, stand about six feet above the plain, some extinct and others containing boiling water.

The waters of the Tatio are derived from meteoric waters which, flowing through rock fissures dating back to the Andean uplift, reach depths where the temperatures are still very high. There they are transformed into steam,[12] which finds its outlets through the same crevices in the rock strata. All indications are that the last stages of

[12] The steam contains about eight per cent of carbon dioxide and hydrogen sulphide, of which the former predominates. Methane and other hydrocarbons do not exist.

FIG. 23—At the geysers of Tatio. Compare Figure 22.

volcanism have been reached, and in the writer's opinion no juvenile waters are being given forth at this time. Temperatures of the steam range to 193° F., whereas the boiling point is 188° F. at this altitude. All of the hot waters are highly saline, but springs of potable water of much lower temperature emerge from the adjacent hillside.

Some years ago a company was incorporated for the purpose of developing the steam resources of the Tatio, thus to provide cheap power for the nitrate industry. A few houses were erected and experimental drilling begun. Then the work stopped, for, whereas an enormous thermal reserve is available, the large capital expenditure required for power production did not appear justified. Meanwhile, the fumaroles continue to pour out their heat to the cold air of the mountains. Picturesque they are, as is the uninhabited region about them, but isolated and inaccessible.

The *quebrada* of the Salado is eroded out of rhyolite, trachyte, and softer volcanics as far as the eastern limits of these flows, below Aiquina. There the surface changes to a younger limestone deposited in beds 100 to 150 feet thick. A unique canyon has resulted where the Salado cuts through the limestone formation. The river flows at a depth of about 50 feet below a gently sloping plain, with width of gorge at the surface only two to eight feet. Within the canyon there is much more space, as if the topping over a subterranean flow had caved in. A bridge, known as the Puente de Piedras, has been constructed as part of the old Indian trail from Chiuchiu eastward. This structure, with a span between abutments of 2 feet and height above river level of 43 feet, probably has a smaller ratio of width to height than any other bridge in the world. One may jump across the chasm with ease, but woe be to the traveler who stumbles into it at

FIG. 24—Present steam outlet beside older vent at the Tatio.

night. The surface of the pampa is unbroken to the very brink of the precipice, and only a high stone monument indicates the place of crossing. The aborigines who built the bridge needed no engineering formulae, and it is probable that their work will remain long after more accurately calculated structures have failed or been replaced.

An ancient river three miles wide, filled up probably from great depths by sediments, meets the Salado at the lower end of its narrow canyon. The stream makes an abrupt bend at this point, following the older watercourse. There are indications that the wide *quebrada*, now dry above its intersection with the Salado, drained the San Pedro valley at an earlier time before volcanic extrusions blocked the way. There must be a considerable underground flow to the Salado through the dry valley, this being the only explanation of the high increase in volume between Aiquina and the confluence with the Loa.

THE LOWER LOA

The limestone deposits encountered in the lower course of the Salado extend westward to include the arable lands of Calama and the lower part of Chiuchiu. Some of these fresh-water limestones are of remarkable purity, those near San Salvador assaying between 60 per cent and 95 per cent calcium carbonate. They have formed where river waters have spread over *vegas*, and the process still continues in the environs of Calama.

At the confluence with the Salado, the Loa's flow reaches its peak. Almost immediately thereafter it begins to lose by seepage through the limestones to an older channel. The waters disappearing in this manner are not lost, however, for the stream which they eventually

unite to form, the Rio San Salvador, enters the main valley at Chacance.

At Yalquincha one of the largest farming districts in northern Chile, that of Calama, begins. Sixteen canals for irrigation and three for water power installations, spread the waters over a cultivated area

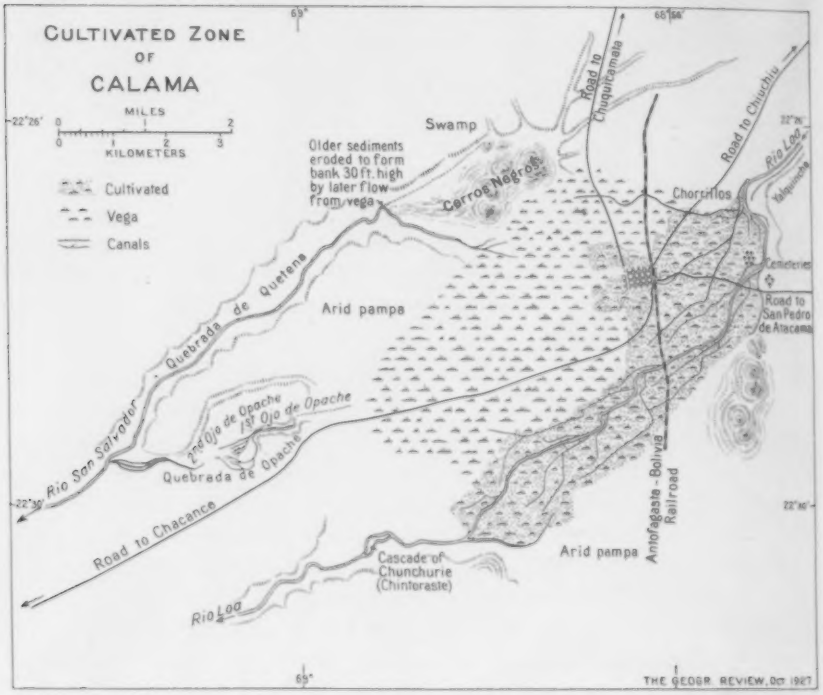

FIG. 25—The cultivated zone of Calama.

of 4400 acres (Fig. 25). A much reduced stream leaves this district, for not only has water been spent upon alfalfa and corn, but there has been seepage into the Quetena and Opache *quebradas* which feed the San Salvador paralleling the Loa at a distance of a few miles. Less than half of the water which enters Yalquincha drops over the cataract of Chunchurie (Chintoraste) where arid desert again closes in. The main falls at this point are 100 feet in height, a picturesque sight. A more impressive view existed in the past, for much of the flow now occupies a channel to the north avoiding the main falls. There are indications that the arroyo Quetena has been formed since the coming of man and is due to irrigation seepage, but the Opache appears to originate from underground flows from points farther up. This stream of 15 cubic feet per second gushes forth from a rock wall and has eroded a narrow box canyon. It disappears and reappears in its course to the San Salvador.

Pumping stations and hydro power installations depend upon the Loa below Chacance, and at Quillagua two irrigation canals are fed. At Calate the small but very brackish stream of the Rio Amargas, the overflow of the Salar de Llamara, is received. From that point to its outlet, the Rio Loa lies hidden in a deep canyon, protected from heavy evaporation losses. At the outlet the volume is but little more than half that at the point of maximum flow. San Roman wrote[13] that the waters disappeared in the sands of the beach at that point,

TABLE I—RAINFALL OBSERVATIONS AT SAN PEDRO STATION, ANTOFAGASTA-BOLIVIA RAILWAY*

(In inches)

YEAR	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	TOTAL
1917	.827	.342	.143	.004	0	0	.04	0	0	0	0	.068	1.424
1918	.596	.493	.66	0	.08	.048	0	0	.083	0	0	0	1.96

* Data from Gustavo Lira: Aguas del Rio Loa, Santiago, 1921. The maximum in 24 hours was 0.294 inches in 1917, 0.31 in 1918. Elevation of station, 3223 meters (10,570 feet).

and this had been confirmed by other travelers before the year 1925. In April, 1927, however, I found that the river had cut a new channel directly into the ocean. Apparently the floods of 1925 had wrought the change.

The statement has frequently been made that the Loa dries up completely during certain seasons of the year. This is not a fact. There are periods of the day when no water flows under the railroad bridge at Quillagua, but this is due to impounding of the entire flow in reservoirs. The river draws its waters from the snows of the Cordillera, a constant supply, and considerable expansion of farming or of industrial enterprises would be required appreciably to increase water losses.

RAINFALL AND EVAPORATION

Over only 2700 square miles of drainage area, hardly more than one quarter of the whole, does precipitation occur except at rare intervals. This area lies above ten thousand feet, and precipitation is usually confined to the months of January, February, and March. Below that elevation there are occasional light showers, perhaps two in a year, with a heavy downpour at ten- or twenty-year intervals. Normal rainfall averages less than 0.04 inches per year.[14] The summer rains contribute perhaps two-thirds of the entire run-off of the Loa feeders. The rest is derived from snows born of condensation on the high flanks of the Cordillera.

[13] San Roman, *op. cit.*, Vol. 3, p. 116.

[14] During the years 1925, 1926, and 1927 rainfall has been abnormally great.

FIG. 26

FIG. 27

FIG. 28

FIG. 26—The pueblo of Toconce. The population is about 70.
FIG. 27—Falls of Chunchurie, Chintoraste.
FIG. 28—A wide spot in the Loa canyon below Quillagua.

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Records of the Chilean Government covering the years 1917 and 1918 show annual evaporation of 128.0 and 106.3 inches respectively at San Pedro and of 182.5 and 179.5 inches at Chacance. The same records report 113.4 inches at Calama and 119.0 inches at Quillagua during the year 1917. Observations at Chuquicamata, at intervals between 1917 and 1927, indicate an average of 144 inches per year. These figures are interesting as a basis for comparison between the aridity of the Atacama Desert and that of other deserts of the world. Observations conducted by the United States Bureau of Reclamation to determine rates of evaporation on reclamation projects[15] showed an average mean evaporation of 122.81 inches per year at Yuma Citrus station over a period of three years of record. The maximum annual evaporation observed at this station, for the year 1921, was 135.70 inches. The next highest rate observed was at Elephant Butte, N. Mex., which was 109.70 inches per year.

FIG. 29—One of a number of cascades occurring in the Loa between Calate and the mouth. Their configuration was greatly changed during the floods of 1925.

Chacance and Chuquicamata are fairly representative of the arid sections of the Rio Loa basin. The stations at Calama and Quillagua were situated within cultivated areas, where relative humidity is high. The San Pedro observations apply to the more humid sections of the Loa basin, although even there evaporation is nearly as great as the average at Yuma.

A comparison of the factors which influence the evaporation rates in the Colorado River valley and the Atacama deserts is also interesting. At Yuma Citrus station, situated upon a desert mesa eight miles southwest of Yuma, mean temperature was observed at 70.7° F., whereas at no point in the Loa basin is the average so high. At Calama, 7400 feet, it is about 57° F. Mean wind velocity at the Yuma station was 3.03 miles per hour, while that of the Loa region is generally

[15] I. E. Houk: Evaporation on United States Reclamation Projects, *Proc. Amer. Soc. of Civil Engineers*, January, 1926.

much greater. At Chuquicamata, for instance, where mean temperature is about 58° F., wind velocity for the year September 1, 1925, to September 1, 1926, averaged 9.81 miles per hour.

Our data on rainfall and evaporation in the drier portion of the Loa basin may be summed up in the statement that the precipitation of ten years is actually less than the evaporation of a single day.

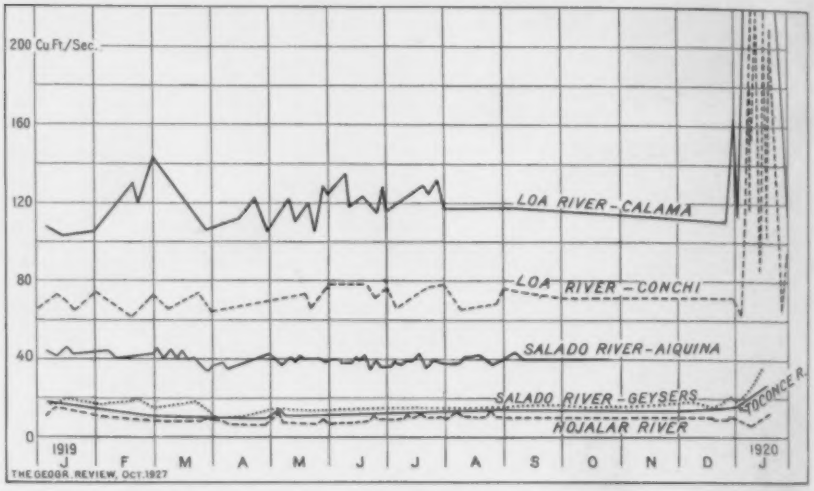

FIG. 30—Flow curves of Rio Loa and feeders from January 1, 1919, to January 31, 1920.

FLOW OF THE LOA AND ITS VARIATIONS

Between the crescent of mountains comprising San Pedro, San Pablo, Inacaliri, Apagado, Linzor, Tocotocare, and the Cerros de Tatio, and a secondary range nearly parallel, in which are Panieri, Leon, Toconce, Copacoya, and the Cerros de Tuina, is a huge basin filled with gravel and sand to a height of perhaps two thousand feet. Water is impounded within these sediments. Thus an immense reservoir is established at the very sources of the river, from which the water emerges as springs at the lower elevations along the inside range. This storage basin regulates the flow in the upper tributaries of the Loa, so that it is fairly constant throughout day, season, and year. The mean flow of the Loa at its maximum stage is 130.6 cubic feet per second, and of this amount 67.0 cubic feet per second ordinarily reach the sea (see Table II).

Flow in the streams at the head of the Loa is nevertheless somewhat higher during the late afternoon and night, because of increments from melting snows during six to eight hours of the day. Diurnal variation depends upon conditions at the heads of tributaries and is not likely to fluctuate more than from 15 to 20 per cent. There are also local variations due to the work of man. Irrigation is for

TABLE II—RIO LOA AND ITS TRIBUTARIES: FLOW AND SALINITY

	Miles from Source	Elevation in Feet	Flow in Cu. Ft. per Sec.		In Parts per Million	
			Average	Normal	Cl	SO_3
Rio Loa—Upper Section						
At Pozo del Miño	0	12,800	0.8		under 100	
At Ojos del Miño	2	12,713	8.1		under 100	
At Rio Chela	19	11,860	above 11.7 below 17.0		about 100	
At Lequena	37	10,843	21.5	19.8	146	178
At Santa Barbara	57	9,810	45.9	35.3		
Rio San Pedro						
Siloli—at sources		14,163	12.4		35	10
San Pedro—at Santa Barbara		9,810	19.2	14.1	195	120
Rio Loa—Middle Section						
Below Rio San Pedro	57	9,810	65.1	55.0		
At Conchi	62	9,560	70.6	61.1		
Below Chiuchiu irrigation	86	8,215	60.0	49.4	403	144
Rio Salado and Feeders						
Toconce—at springs		13,287	14.0	13.5	62	50
Hojalar		13,878	10.6	10.0	over 1,500	
Salado—at geysers		14,167	14.8	14.0	4,201	48
Caspana		12,224	4.2	4.0	about 100	
Salado at Aiquina		9,580	45.9	37.1	over 1,500	
Salado at Chiuchiu		8,215	70.6	51.2	1,548	76
Rio Loa—Lower Section						
Below Rio Salado	86	8,215	130.6	109.5	1,126	115
At Yalquincha	104	7,871	123.6	102.4		
At Chintoraste	111	7,005	59.0	30.0	1,292	131
At Chacance	151	4,101	76.6	45.9		
San Salvador—at Chacance		4,101	26.0	22.2	1,996	264
Loa below Rio San Salvador	151	4,101	102.6	68.1		
At Quillagua (above irrigation)	206	2,733	84.8	45.9	2,088	288
At Quillagua (below irrigation)	210	2,500	70.6	30.0		
At Calate	231	1,877	81.9	51.0		
At Pacific Ocean*	252	0	67.0	36.0		

*Waters of Pacific Ocean near mouth contain 19,391 parts per million of chlorine and 2376 parts sulphuric acid radical.

the most part carried on during the daylight hours, causing the river to rise during the night by the return of water as well as the closing of the canals. Opposite variations are effected by hydro power stations in the lower sections, where the water is stored at night and passes through the turbines during the day.

On account of the wet season in the upper reaches of the Loa watershed, summer flow is somewhat higher than during the rest of the year. A second factor of seasonal variation is introduced by irrigation. The irrigating season is from September to March and uses up a considerable portion of the flow. Part of the water seeps back to the river, but from one-third to one-half is lost at each farming center.

The Small Annual Variation

While the summer is the season of rainfall, there have been years when there was scarcely any precipitation in the Cordillera. It might be expected that the Loa feeders would dry up altogether under such circumstances. This has not been the case.

The flow chart (Fig. 30) covers a year during which there was no appreciable precipitation. This year was so dry that by September the western flank of the frontier range was nearly devoid of snow. Nevertheless, observations during the winter months of 1919, when the diminution in the water supply would presumably be reflected, showed a flow nearly up to the average of previous years. Where did the water come from?

The lower portions of the Cordillera Occidental consist of uplifted stratified rocks reaching elevations of 14,000 feet. Above them have been thrust forth immense volcanic extrusions, forming a chain of mountains with peaks reaching altitudes as high as 20,000 feet. The Bolivian *altiplanicie*, lying between this range and the folded sedimentary rocks forming the Cordillera Oriental, is a region of enclosed drainage. Near the 22nd parallel of latitude the surface is divided into a number of pampas without outlet, each with a lake fed by waters from the surrounding mountains. Nearly all of these interior drainage basins are above 14,600 feet.

Referring to the map (Fig. 3), it may be noted that the Laguna Colorado,[16] the largest of these lakes, is situated just above the springs from which the rivers Toconce, Hojalar, and Salado rise, with only the frontier range intervening. Similarly, the lake called Aralaguna lies above the springs of the Rio Siloli, while the particularly wet salars of Ascotan, Carcote, and Ollagüe occupy similar locations with respect to the upper Loa. It is natural to assume that there is a subsurface flow along contacts of old and new formations. Such flows would derive their waters from the eastern slopes of the Cordillera Occidental, which experience no severe droughts. A constant supply of water is thus available for the Loa springs at all times.

Here it may be mentioned that there are indications that the valleys were continuous at one time, the entire Bolivian *altiplanicie*

[16] See F. C. Walcott: An Expedition to the Laguna Colorada, Southern Bolivia, *Geogr. Rev.*, Vol. 15, 1925, pp. 345–366.

FIG. 31

FIG. 32

FIG. 33

FIG. 31—View toward the Coast Range from a point about one-quarter mile above mouth of Loa.

FIG. 32—View downstream from a point about one-half mile above mouth of Loa. The irrigation canal which had been used by present-day Changos prior to the floods of 1925 is slightly at the left of center, their shelter (see Fig. 5) in rear.

FIG. 33—The mouth of the Rio Loa, as seen from the trail descending the coastal escarpment.

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TABLE III—RIO LOA: RAINFALL AND FLOOD OBSERVATIONS ONE-HALF MILE BELOW CONFLUENCE WITH RIO SALADO, JAN. 1 TO FEB. 15, 1925

Jan. 1 to 25 . .	Maximum flow of river 93 cu. ft. per sec., minimum 83 cu. ft. per sec., latter occurring during afternoons owing to irrigation losses. River at abnormally low stage owing to 2 years of drought in the cordillera.
Jan. 26	Hard rain 3 to 9.30 p. m. (rain is most unusual at this place). River rose 4 ft. during night. After 4 hours of high water it dropped rapidly to 1 ft. above normal.
Jan. 27 to 30 . .	River 1 ft. above normal.
Jan. 31 to Feb. 1	River 6 inches above normal.
Feb. 2	Rain 4 p. m. to 10 p. m.
Feb. 3	Rain 5 p. m. to 7 p. m. River rising.
Feb. 4	Crest of flood at 4 a. m., river reaching 7 ft. above normal. Rain 5 p. m. to 7 p. m.
Feb. 5	Crest of flood at 4 a. m., river reaching 9 ft. above normal.
Feb. 8	Rain 5 p. m. to 6 p. m.
Feb. 9	Rain 5 p. m. to 6.30 p. m.
Feb. 10	Crest of flood at 4.30 a. m., river reaching 8 ft. above normal.
Feb. 11	Rain 5 p. m. to 7.30 p. m.
Feb. 12	Crest of flood at 2 a. m., river reaching 5 ft. above normal.
Feb. 13	Crest of flood at 4 a. m., river reaching 10 ft. above normal. Flow at crest of flood about 7250 cu. ft. per sec., most of the water coming from Rio Salado. Topography of river channel found to be completely changed after passing of flood.
Feb. 15	Crest of highest flood at early morning, river reaching 18 ft. above normal. Flow estimated at 15,072 cu. ft. per sec. by Kutter's formula but actually perhaps more. Flood came from both Salado and upper Loa. It destroyed bridge at Chiu-chiu, and flooded streets of Calama.
	Rain 2 p. m. to 5.30 p. m.
General notes .	Crest of flood at early morning lasted only a few hours in each instance, water then dropping to within 1 or 2 ft. above normal flow. There were also small rises each afternoon during the rain period, beginning about 4 p. m. and reaching about 3 ft. 6 in. above normal.

draining into the Pacific Ocean through the Loa. At present Lake Titicaca flows to Lake Poopo, which in turn feeds a small amount of water to the Salar de Coipasa. Farther south are other salares, a series of evaporating pans separated from the upper course of the Loa by a single volcanic range. It is well within the realm of probability that prior to the extrusion of volcanic materials which increased the height of the Cordillera Occidental just east of the northern sources of the Loa, a drainage channel extended from lake Titicaca southward into the Loa. Springs which exist along the eastern side of the Loa canyon in this section indicate that some water is still flowing this way. When the egress in a southerly or southwesterly direction was

disturbed, a large lake would have been formed, covering much of the *altiplanicie*. The overflow from this lake may have cut through the eastern Cordillera at the La Paz gorge to enter the Amazon system. It is recognized that immense lakes covered the high plateau during certain stages in geologic history[17] as a result of the glaciers which blocked the outlet toward the east at the gorge of the La Paz River. Such lakes should not be confused with the one which I suggest as having been caused by the volcanic dam at the southwest, the latter having been formed at an earlier time, although after the Andean region had attained much of its elevation.

Floods

Floods occur in the Loa during each period of heavy rainfall. The impermeability of the rock walls which enclose its feeders, as well as the stream slopes, are such as to lend little facility to escape of water to underground reservoirs, except those at the uttermost reaches of the system. Torrential rains have occurred in the Loa basin at odd intervals. The last was in 1925, this being contemporaneous with the supplanting of the cold north-bound Humboldt Current along the coasts of Peru and Chile by El Niño, a warm stream flowing south.[18] It is likely that the floods of 1925 were the greatest in the recent history of the Loa. The writer had had occasion to study river flow during the latter part of 1924, and to that end established a current-meter station a short distance below the Salado confluence near Chiuchiu. Inspection of the walls of the canyon to determine river heights during earlier floods disclosed driftwood and débris at points 8 feet above river level. Oldest inhabitants of Chiuchiu had no recollection of the water rising above that level. Notes of the observer at the measuring station (Table III) form a unique record to be added to the written chronicles of rainfall and floods of the Atacama Desert. Other changes caused by these floods may be noted throughout the lower course of the river. At the pumping station near Toco the stream adopted a new course with water level now 15 feet lower than formerly. The operator of this station stated that, whereas the water had been generally clear prior to 1925, there had been mud and sediment through the two years following the floods, resulting in continued trouble at the distilling plant.

Salinity

Reference has already been made to the brackish quality of the Loa waters. In general it may be said that there is increase in salt

[17] A. G. Ogilvie: Geography of the Central Andes, *Amer. Geogr. Soc. Map of Hispanic America Publ. No. 1*, New York, 1922.

[18] R. C. Murphy: Oceanic and Climatic Phenomena Along the West Coast of South America during 1925, *Geogr. Rev.*, Vol. 16, 1926, pp. 26–54.

content throughout the entire course of the Loa from the Ojos del Miño to the mouth. At no point is there a tributary received containing less of chlorides and sulphates than the main stream itself at the point of junction. Then there is the constant evaporation, though this is apt to be overestimated. Between Chacance and the mouth of the Loa, a distance of 101 miles, the toll of evaporation from the river, not considering that in the Quillagua farming district, is hardly more than one cubic foot per second, less than two per cent of the volume flowing between the two points.

According to standards of the Chilean Government good water for irrigation should not exceed 200 parts per million in chlorine content. Actually the only farming districts in the entire Loa basin which have such waters are those of Santa Barbara, Toconce, and Caspana. Even at Chiuchiu, chlorine is double the percentage stipulated, although good crops of some vegetables are raised. Above the Salado confluence, all waters of the Loa are fit to drink, although those of the Rio San Pedro have a mild purgative effect. Below this point no water is used for drinking except where evaporators have been installed. In Calama, where chlorine content is more than six times the tolerance, only alfalfa and corn are grown. Even so cultivation exists at Quillagua, where the salt content is over ten times the figure set by the Chilean government.

The composition of the saline matter in the Loa is very different from that of ordinary river waters, rather resembling that of ocean waters.[19] It is believed that the soluble matter of the Loa is in a large part derived from volcanic sources, through the decomposition of tuff by waters charged with fumarolic products. The theory has also been suggested that, in consideration of the geologic history of the region, not all the salts are of such origin. As the Desert of Atacama emerged from the Cretaceous sea, a vast amount of saline matter must have crystallized out in shrinking basins, later to be uplifted and covered with igneous materials. Such unexposed beds may now exist to be traversed by the waters of hot springs on their way to the surface, particularly by those at the head of the Salado. The fact that the sodium chloride is so much greater than the aggregate of all the other salts of the Loa waters supports this theory.

Salt content of the waters throughout the basin is increased 50 per cent or more during the rainy season, by the dissolving of saline efflorescences by the rains that wash the grounds in the upper part of the basin.

[19] Analysis of the semi-potable Loa waters at Lequena shows 31.5 per cent of the salt content to be sodium chloride, 17 per cent sodium sulphate, 14.5 per cent magnesium sulphate, 7 per cent calcium sulphate, and 19.5 per cent calcium carbonate. In the Salado, sodium chloride is the predominating salt, amounting to 80 per cent of the total salinity; and, as it is the Salado that furnishes the major salt content of the Loa, sodium chloride forms the bulk of substances in solution in the main stream below the confluence.

Underground Waters

Surface conditions of the Atacama Desert are such as to favor subterranean flow of water. A mantle of porous sediments covers much of the ground to depths of about 100 to 200 feet, while below lie stratified rocks of the Mesozoic age which are not all impermeable.

But little investigation has thus far been made of these hidden waters in the Loa drainage basin. It is possible that they are far greater in amount than those flowing at the surface. Outcrops of the underground waters occur at various places throughout the region, those in the most arid parts often being waters of good quality. But the major portion of these waters disappear never to be seen again, doubtless reaching the sea through passages in the Mesozoic sedimentaries. Some of the subterranean flows have been exposed at the great fault along the coast, there being 62 springs of good water between the mouths of the Rio Loa and the Rio Copiapó listed by San Roman.[20] It does not follow, however, that all of these springs are derived from waters of the cordillera—for condensation from the *camanchacas* which form and dissipate upon the west side of the Coast Range may also be a source of supply.

The great porosity of some surfaces of the Desert of Atacama was shown when the writer had occasion to divert a stream of about 200 tons of water per day. The water directly disappeared into the ground, and after several months of such flow there was not even an appearance of dampness at an excavation 70 feet deep situated 500 feet farther down the valley.

[20] San Roman, *op. cit.*, Vol. 3, pp. 115–123.

ISOLATED RACIAL GROUPS OF HUNGARY

Erdmann D. Beynon

IF the traveler to Hungary forsakes the usual haunts of tourists to wander into the more remote regions, he will discover, scattered over Hungary and even beyond the borders of the present state, a number of secluded sections where inhabitants, though speaking only the Hungarian language, yet differ in a marked manner from the Magyars[1] around them in costume, dialect, and folk customs, while in each respect these groups show a remarkable similarity.

The problem of the origin of these remote groups is one that Hungarian ethnologists have struggled with for a long time. One thing is certain: they have absolutely no racial connection with the Germanic, Slavic, or other peoples with which the Hungarians have for many centuries been surrounded. They differ in certain respects from other Hungarians; yet in these very matters of costume, dialect, and folk customs the mass of the Magyar people shows far more decidedly the influence of neighboring peoples than does the population of these sections. One of the most notable features of their dialects is the absence of loan words which occur in great abundance in the speech of modern Hungary. I myself have had experience of the reality of dialectic differences during the course of my church work among Hungarians. My church has a constituency of about two thousand, Hungarians from every section of the home country. So long as they speak in ordinary Hungarian they understand each other: how many tell me they cannot comprehend the speech of Göcsej or Sárköz or Mezőkövesd! Szinnyei József's "Dictionary of Dialect," it may be noted, deals largely with the dialects of these isolated groups. Historical documents also confirm the racial differentiation of the groups.

The people of these sections usually claim with pride that they alone are pure-blooded descendants of the ancestral Magyars and that they alone have preserved the ancient manners of the race; ethnologists formerly assented to this view, supposing that seclusion had

[1] For the purpose of this article it is necessary to make a distinction between the descendants of the Home Taking Magyars and the mass of people who today call themselves "Magyarok." Thus the people of every one of the isolated groups referred to consider themselves "Magyarok," although none of these groups is descended from the Magyars of the Invasion. To make this distinction more clear I shall take the liberty of using the native term, Magyars, only in reference to the seven tribes that entered Hungary at the time of the Invasion and to their descendants. I shall use the English term, Hungarian, in the wide sense in which it denotes all, whether of Magyar ancestry or not, who have become a part of the Hungarian people as we find them today. Thus these isolated groups may be referred to as Hungarian but not Magyar.

preserved the ancestral speech and customs.[2] During the last quarter of the nineteenth century and the first years of the twentieth a strong school of ethnologists has arisen in Hungary who hold that, though isolation doubtless favored the retention of ancient characteristics, close study of the case warrants no other conclusion than that these groups represent broken fragments of non-Magyar but related peoples. Where the seclusion was not sufficient, as in the case of the Kunok and Jászok of the Alföld, the ancient racial characteristics disappeared and the tribes became completely merged in the Magyar population around them. There are, however, many other secluded regions as, for example, the valley of the Tarna in the county of Heves, whose inhabitants differ in no way from the ordinary Magyar people. The striking difference is observable only in those sections in which racial non-identity has been made more pronounced through long seclusion. One of the greatest difficulties in the study of Hungarian folklore is that the separate origin of much of the folklore of these detached regions has not yet been sufficiently recognized.

The Sárköz[3]

In the County of Tolna, between the mountain of Szekszárd and the Danube, just across from Baja there lies a large level tract of exceedingly rich soil, the territory of the four villages of Öcsény, Decs, Sárpilis, and Alsónyék. The fertile land from which these villagers today reap abundant harvests was only a few decades ago a great swamp, from which the region derived its name of Sárköz—Country of Mud. The hard struggle for existence in those days compelled the men of the villages to remain absent from home a great part of the year, during which time they either fished along the shallow watercourses of the marshland or else sought pasturage for their herds and flocks on the banks of the swamps. The women remained at home in the little villages, which were set as islands in the waste of swamp.

[2] A good example of the old viewpoint is Résö Ensel Sándor's "Magyarországi Népszokások," which was published in Pest in 1867. Interesting customs from all sections of the country are collected and treated as due in all cases to isolation. Ipolyi Arnold, in his "Magyar Mythologia," published in Pest in 1854, takes no account of the racial difference back of the customs of certain sections. Even Kandra Kabos, in his "Magyar Methologia," published at Eger in 1897, assumes that the customs of all the isolated regions are genuine Magyar customs and that isolation alone led certain sections to preserve the old customs.

The newer view, as set forth in this article, was first brought forward by Hunfalvy Pál, in his "Magyarország Ethnographiája," published in Budapest in 1876. That book revolutionized Hungarian ethnological thought in many ways, not least in its insistence on the place that the Besenyők, Kunok, Tatárok, etc. occupied in the composition of the Hungarian people. Since Hunfalvy's day different ethnologists have made detailed studies of the different isolated groups. Their works will be referred to in connection with the groups they studied.

[3] The most valuable work on the ethnology of the Sárköz is Malonyay Dezsö's "Magyar Nép Müvészete," Vol. 4, 1912, pp. 53–94. The poet Garay János was born in the neighboring city of Szekszárd. He has left an interesting account of the Sárköz in the olden days, Vol. 5, 1887, pp. 259–262. I myself was a guest at the home of Rev. Szilágyi Béla, Reformed Church pastor of Öcsény, and am acquainted with Rev. Szappanos Gyula, Reformed Church pastor of Alsónyék. From these clergymen as well as from the people themselves I learned of many customs not mentioned in the books referred to.

FIG. 1—Map of Hungary and adjacent territory showing isolated racial groups classed as Hungarian but of non-Magyar though related origins. (For a general ethnic map of pre-war Hungary see the series by B. C. Wallis in the *Geogr. Rev.*, Vol. 6, 1918.) The boundaries of present-day Hungary are shown in a heavy dot-and-dash line; the former boundaries in a line of fine dashes.

The area occupied by Palócz people cannot be exactly defined. Their characteristics are best exhibited in the area of more intense shading (Pétérvásári district of Heves county): on the east, i. e. on the western slopes of the Bükk Mountains the people are known by the name of Barkó, but they are generally identified with the Palócz. The Székely are less numerous in Maros Torda county (lighter shading) than in the other three Transylvanian counties they occupy. Scale of map approximately 1:5,000,000.

Being left alone, they developed to an abnormal extent two of the tendencies found among the women of all these remote sections: the tendency, on the one hand, to find employment in the weaving and embroidering of beautiful folk costumes for themselves, and, on the other, to seek social life in clubs or guilds, each composed entirely of girls or women of a particular age.

Since the marshes have been drained and transformed from a worthless waste into land of almost incredible fertility, these people have suddenly found themselves the richest villagers in all Hungary; yet in spite of the changed conditions many of the old habits of life remain. As in the days when their husbands were occupied with fishing or herding, the women even now do little work other than the embroidering of their costumes. The only difference is that they are rich now and can afford to buy the most expensive materials. When Malonyay Dezsö studied these villages in 1912, he found that the average girl's costume was worth 600–800 gold korona, i.e. $120–$160.[4] When I visited these villages in 1925, I was told by many of the people that an average girl's costume costs now at least the equivalent of $300 and that every girl of well-to-do family possesses several costumes. In spite of the increased costliness of the materials used, the same folk motifs are embroidered on the silk of today as were worked into the homespun of two or three generations ago. When the village women deck themselves out in their finest array and assemble in front of the Reformed Church on Sunday morning—all the people of the Sárköz are stanch Calvinists—the effect is almost indescribably beautiful. Malonyay compared it to a flower garden in which red and lilac colored flowers predominated against a green background: the silk dresses are very often green, and the embroidery shows almost every conceivable shade of red and mauve. Scattered among the bright colors are dresses of pure white; for white is the color of mourning in the Sárköz, just as it is in Csököly and the Ormánság.[5] My own impression of the distinctive quality of the dresses worn in the Sárköz is that, while the colors are bright, yet there is no such sharp contrast as in the color scheme of the dresses of Mezőkövesd. There is here a softer and more harmonious blending.

Several customs are connected with the wearing of these costumes, many of them not limited to the Sárköz but more or less prevalent through all these detached groups and even beyond them. Such a custom is that whereby a woman shows her family's wealth and importance by the number of petticoats she wears under her gloriously embroidered apron. Very often from thirteen to seventeen petticoats are worn, and the wearer is able only with great difficulty to enter the church door. The headdress of a woman indicates her condition,

[4] Malonyay Dezsö: Magyar Nép Müvészete, Vol. 4, p. 79.
[5] *Ibid.*, p. 58.

and the color of her clothes her age. There is a particular headdress—the *párta*—formerly with seven horns, to indicate the unmarried woman. Another headdress is substituted for this on the morning after her wedding. After the birth of her first child, her headdress is again changed. As the woman grows older she abandons more and more the gorgeous clothes of her girlhood. At forty she wears only white: at fifty only black. Yet in her coffin she is able once again to wear her bridal costume.[6]

FIG. 2—Young woman of the Sárköz from Alsónyék in bridal attire.

A peculiarity of several of the Sárköz customs is the exclusion of men from the social group. Every girl becomes a member of one of the village bands, consisting of from fifteen to twenty girls under a recognized leader. Together they attend school; together they attend church on Sunday morning; together they take part in the peculiar dance in which no man is allowed to participate.[7] After the birth of a child to a young married member of the band the somewhat mysterious custom of *csöröglö* is held: this is a sort of baptismal rite, wholly pagan in character and handed down from pre-Christian times.[8] At the *csöröglö* only women may be present. After the rite some one is sent to announce to the father the birth of his child, just as in the old days when he would be far absent with his flock or fishing boat or be engaged in dressing the vineyard on the mountain side, and it is only after this announcement that the father is allowed to see his child. Another ancient custom is that of the *istenfa*—God's Tree—usually a rosemary shrub set out in the courtyard of each home. Before the woman of the house greets male visitors, she walks around the *istenfa* in order to secure protection from evil spirits.[9]

Some of the old customs have now been dropped altogether. No

[6] *Ibid.*, p. 54.
[7] *Ibid.*, p. 59.
[8] *Ibid.*, pp. 70–72.
[9] *Ibid.*, p. 74.

longer do the youths chase the maidens through the vineyards and become betrothed to the one they are able to catch.[10] Today marriage among these people is almost entirely a property consideration, worked out by the families of the prospective parties with a view to the enlarging of their estates. With a similar ambition before them the people have adopted the practice of birth control and limit the number of their offspring strictly to one child in the family.[11] The worst effects of a rigorous birth control are perhaps more manifest in the Sárköz and in the neighboring Reformed Church communities of Csököly and the Ormánság than anywhere else in the world. The few children are usually very delicate; and most students of the situation predict that, though there are still between eight and nine thousand of these interesting people, in a few more decades they will be entirely extinct. There are not as many of them today as in 1720, when their ancestors were serfs on the domains of the Roman Catholic abbeys of Szekszárd and Bátaszék. Every traveler to these villages comments on the gloominess and desolation so discordant with the wealth of the villagers. Many houses are vacant: the families who lived in them have died out completely. Though the houses are large, the small family—grandparents, parents, and the only child—find one or two rooms at the back sufficient for them to live in. All the spacious front rooms are unoccupied save by spare beds which are never used and by wardrobes in which are kept the gorgeous costumes of the women. This same desolation is to be observed in an even more marked degree among the less wealthy vil-

FIG. 3—Young man of the Sárköz from Öcsény in horse-boy costume.

[10] *Ibid.*, pp. 68–70. See Garay János' account in the same work, Vol. 5, pp. 261–262.

[11] Malonyay Dezső, *op. cit.*, Vol. 4, pp. 66–68. For the former population of the Sárköz see Daróczy Aladar: Tolna Vármegye Leirása, Vol. 1, 1909, pp. 39 ff.

lagers of the Ormánság and Csököly. As Mr. W. Stanley Lewis has suggested, the practice of birth control has been introduced through contact with Swabian settlers from South Germany. The pastor of Öcsény assured me it was due to the presence of South German office-holders who had been placed in the villages by the Austrian government after the collapse of the revolution of 1848.

A careful study of the people of the Sárköz along with an examination of the oldest documents relating to these villages shows almost conclusively that, in spite of their claim to be pure-blooded descendants of the ancestral Magyars, they are not Magyars at all but are descended from a tribe of Cumanians (Kunok) which joined the Magyars in the neighborhood of Kiev in those days before 896, when the Magyars under the leadership of Álmos and Árpád were marching toward the Carpathians and their present home.[12] These Cumanians were of an Ural-Altaic stock, closely related to the Magyars themselves. Unlike their kinsmen—Kunok and Jászok—who entered Hungary in the thirteenth century and occupied extensive tracts in the Great Plain or Alföld between the Danube and the Tisza and east of the latter river, these Cumanians who entered at the time of the Invasion have retained their ancient customs. Those of the Alföld, on the contrary, have become completely merged with the Magyar people around them. Only the names of their towns and villages indicate their separate origin. Doubtless it was the long isolation caused by the marshlands of the Sárköz which has preserved this distinctive type, while their kinsmen have completely lost their identity.

The Ormánság[13]

In the southwestern part of the county of Baranya, between the mountains of Siklós and the Drava River there is an extensive tract of level plain covered over with dense, almost primeval forests. In the clearings and farm lands scattered through these forests there are to be found the forty-four villages of the Ormánság. This does not mean that every inhabitant of these villages belongs to the distinctive group known as people of the Ormánság. Many are newer settlers who have occupied houses left desolate by the exercise of birth control to which reference has been made. Many again are servants on the estates of the great noblemen to whom most of the forests of this region belong. Hence out of a total population of 23,798 in 1900 (the census of 1920 gives 20,611) only 17,368 really belong to this ethnological group. The members of this group call one another "brethren" and distinguish them from other peoples by three signs—their

[12] Malonyay Dezsö, *op. cit.*, Vol. 4, p. 72; Garay János, *ibid.*, Vol. 5, p. 260.

[13] The work of Lukácsy Imre, Reformed Church pastor of Diósviszló, entitled "Ormánság Népe," is invaluable. Though quite brief, only 28 pages, it gives all the needed information. Várady Ferencz: Baranya Multja és Jelenje, Vol. 1, 1896, pp. 170–218, is rhetorical and poetical rather than scientific.

Hungarian speech, their membership of the Reformed Church, and their wearing of the *kebel*, the distinctive dress of the Ormánság, a particular kind of white petticoat.[14]

The people of these forest villages have many peculiar customs. The very construction of their houses retains a reminder of the old nomadic days. The houses are not set firmly on the ground but on four rafts, as though to make it easier to move the *talpas ház*, as this is called, from place to place. The same type of house is found among the Székely people in Transylvania.[15]

The most interesting of the Ormánság customs is the *Alkudozás*—the bargaining which precedes the engagement of a young couple. In all Hungary a girl of marriageable age is called *eladó*, ready for sale, and in the Ormánság this expression takes on its full meaning. In the bargaining, the young folks themselves have least to say; in fact, the bargaining is usually done without even their knowledge. The representatives of the two families along with the broker or agent meet together and discuss the exact amount to be paid by the family of the bridegroom to that of the bride. Often a wedding contract is canceled because of a dispute over a thousand korona or an extra headdress. Even the minutest details are discussed at this conference, including the price to be paid by the wedding guests for the bride's kisses.[16] If a family have no sons, in similar fashion they buy a son-in-law, who is then known by the name of his father-in-law.[17]

Study of their customs leads one inevitably to the problem of the origin of the Ormánság. Though living just across the Drava River from Slavonia, their dialect has surprisingly few loan words of Slavic origin, and on account of the long Turkish occupation many Turkish traits are still to be met with. The very name, Ormánság, is derived from the Turkish word, *orrmán*, meaning "forest"; but it is applied to this region in old documents antedating by centuries the Turkish occupation.[18] The women do not wear veils over their faces but cover them with shawls in the winter time, leaving only their eyes visible. They say that they do this to protect the skin, but a stranger would be certain that he saw Turkish women of the old régime. They paint their faces to make a sharper contrast with the white costume which they wear. Yet we know that the people of the Ormánság, as well as

[14] Lukácsy Imre: Ormánság Népe, p. 6. The usual meaning of the word *kebel* (also *kebél*) is bodice. In the Ormánság, however, but only there, it denotes a petticoat (see Luckácsy, p. 22).

[15] *Ibid.*, p. 16.

[16] *Ibid.*, pp. 24–25. This custom of marriage arrangement between the parents is by no means confined to the Ormánság any more than is the custom of showing wealth by the number of petticoats confined to the Sárköz, Ormánság, and Csököly. I have referred to these customs here because for some reason they have a prominence here greater than in most other places.

[17] *Ibid.*, p. 26. The custom of Vőszállitás has, so far as I know, few parallels elsewhere.

[18] Dr. Stefan von Györffy, Director and Custodian of the Ethnographical Division of the Hungarian National Museum, points out that there are three strata of Turkish loan words in the Hungarian language. The first, tenth century, is Bulgar-Turkish; the second, from the time of Arpád, is Kun-Bessenyö; the third is Osmanli-Turkish.

the name of their region, have a history that reaches back long before the Turkish period. It is now generally held that they are descendants of the Avars, a race which seized Pannonia after the overthrow of Attila's Hunnish Empire. We know very little about the Avars save that they were of Ural-Altaic stock, like the Huns and the Magyars, and that their dominion in Pannonia was short-lived and had melted away before the Magyar invasion of 896. It has been supposed that at the downfall of the Avar kingdom a great many of this somewhat mysterious race took refuge in the dense forests between the mountains and the marshes on the borders of the Drava River. They welcomed the coming of the Magyars, for they were their kinsmen, and the Magyars in turn left the people of Ormánság in possession of the land they had won from the forests.[19]

Csököly[20]

The smallest of these isolated racial groups is that of Csököly, a village of 1615 inhabitants in the county of Somogy, not far from Kaposvár.[21] Like the people of the Sárköz and the Ormánság, the people of Csököly are stanch Calvinists; like those also they are a dying people because of birth control. In 1925 it was estimated that only sixty families of the old stock were left in the village. In one year there were three births and twenty-six deaths. The 43 young men from Csököly who died on the battle fields of the World War were all only children. The few children who are born now in the village are weak and sickly.

While many of the younger women are now abandoning their folk costume, that worn by the older women of Csököly is renowned throughout Hungary. White is the color for mourning: embroidery is allowed only on the headdress and the sleeves of the waist. Girls are married young in Csököly: at the time of my visit only three girls in the village had reached the age of 14 years without being married.[22] As in the Sárköz the tolling of the church bells indicates the sort of person who has died. For a man the bell is tolled 12 times at Csököly;

[19] *Ibid.*, pp. 6–12. Rev. Mr. Lukácsy discusses very thoroughly in this place the origin of all the detached groups and the relationship between them. He quotes such high authorities as Dr. Sebestyén Gyula, formerly Curator of the National Museum of Budapest.

[20] There are other such isolated villages. I have dealt with Csököly because there is an excellent monograph on it by Gábos Dénes, "Csököly Község Monografiája" in the April, 1925, number of *A Falu*, the organ of the Faluszövetség, or Village Society of Hungary; and also because of its pronounced individuality. I myself lived for some time in the County of Somogy and was always told that Csököly was "very peculiar." A short description of Csököly is also to be found in Malonyay, *op. cit.*, Vol. 4, pp. 106–107.

[21] The neighboring village of Szenna, in the Kaposvári district of Somogy county has a great many points of similarity with Csököly. It, too, is a Reformed Church village with a population rapidly dying out because of birth control. Its costumes, however, as shown by Malonyay, *op. cit.*, Vol. 4, p. 115, show quite a divergence from those of Csököly. I know of no one who has yet made a special study of Szenna. Its population at present is reckoned to be 972, according to a census taken last year, although in 1919 it was said to have 1647 inhabitants.

[22] Gábos Dénes: Csököly Körség Monografiája, *A Falu*, Vol. 6, 1925, No. 4, p. 299.

for a woman only 10 times. Like the people of Göcsej those of Csököly retain pagan customs connected with the birch tree. On Good Friday they strike their pigs with birch wands so that they may escape hog cholera.[23]

The people of Csököly form a much later settlement than those of the Sárköz or the Ormánság. After the Tatar Invasion of 1241 during the reign of Béla IV, Hungary was almost completely destroyed. Early in the spring of the following year the Tatars retired, vanishing almost as suddenly as they had come. The Great Khan had died in his camp beyond the Volga, and the leaders, Batu and the others, hurried home to share in the spoils. Yet a few remnants of the great Tatar horde did not return with Batu Khan to Asia. They married Hungarian or other native women and settled down in isolated sections of Hungary. Such was almost certainly the origin of the people of Mezőkövesd and the Kalotaszeg. In the case of Csököly, it is generally held that the women whom the deserters from the Tatar horde married were probably Slovaks who had been left in this section by the conquering Hungarians. Whether that is so or not, the culture of Csököly shows no Slovak trace but retains much that is apparently of Tatar origin.[24]

Göcsej and Hetés[25]

In the western part of the county of Zala, adjoining the Jugoslav frontier, is one of the largest in area of the isolated ethnological group regions of Hungary. The names Göcsej and Hetés have neither political nor historical significance: and it has never been satisfactorily explained why this region should thus be divided into two parts, since it forms an ethnological unit. Göcsej includes 89 villages. Immediately adjoining it on the west is Hetés with 17 villages. The villages are all small, the average number of inhabitants of a single village being about 550. The entire population of Göcsej is now about 53,000, and that of Hetés about 8600.[26] The eight western villages of Hetés were ceded to Yugoslavia by the Treaty of Trianon; with this exception the entire region still remains in Hungary.

Göcsej and Hetés do not derive their fame from the folk costumes worn by their people—though these are distinctive, they lack the

[23] *Ibid.*, p. 298.

[24] *Ibid.*, p. 297.

[25] For the regions of Göcsej and Hetés there is a book of outstanding value, Gönczi Ferencz: Göcsej, 1914. Its 689 pages are filled with the superstitions and folk customs of this interesting people: little information may be gleaned from any other book which is not to be found in Gönczi. Apart from some notices in Malonyay's work, Vol. 4, there is an interesting little book of Göcsej folk songs, selected by Abafi Lajos from Kováry Béla's collection and published at Vácz in 1876. It is entitled "Göcseji Népdalok" and contains 214 songs along with an excellent introduction. In "Az Osztrák-Magyar Monarchia Irásban és Képben," Volume 4 of the Hungarian section, 1896, contains a description of the villages of Göcsej by Eötvös Károly. This description covers pages 235–248. Gönczi criticizes Eötvös as being unscientific.

[26] Gönczi Ferencz, *op. cit.*, pp. 19–29.

beauty of the costumes of the Sárköz—but from their superstitions: they are known as the most superstitious regions of all Hungary. Every moment of the villager's life, from the cradle to the grave, every day of the year, every article of household furniture, every domestic animal, every phase of the agricultural life was and, in many sections, still is dominated by ancient pagan rites, customs, and beliefs, though the people consider themselves Christian—93 per cent of the people

FIG. 4—A typical house in the Göcsej area, western Hungary.

of Göcsej and 98 per cent of those of Hetés being Roman Catholics. In some villages they still retain the custom of walking nude around the house before dawn on Good Friday morning, in order that the evil spirits may not bother them throughout the year.[27] They put birch branches in their windows on St. George's Eve, because the birch was sacred to the old pagan goddess of the spring and they believe this will secure her protection from the powers of evil.[28]

The dialect of the people of Göcsej is quite different from ordinary Hungarian; some scholars go so far as to say that it is practically a distinct language.[29] Yet it has many similarities with the speech of the Ormánság. On the other hand, the striking likeness between the speech of Göcsej and that of the Székely people in the east of Transylvania has led many to believe that they are both branches of the same stock.

The most probable explanation of the origin of the people of Göcsej is that they are a mixed race—Avar and Besenyő.[30] After

[27] *Ibid.*, p. 243.

[28] *Ibid.*, p. 251.

[29] *Ibid.*, pp. 487–490. Torkos Sándor, Toldy Ferencz, Vass József, Kardos Albert are cited among others who hold this view.

[30] *Ibid.*, pp. 91–92. Gönczi here discusses the relationship among the Székely, Palócz, and Göcsej peoples.

the defeat of the Avars by Charlemagne, many of them took refuge in the forests of this region as well as in those of the Ormánság. Later on the Besenyők or Petchenegs were settled among them and mixed with them. The coming of these Besenyők was very interesting. They were an Ural-Altaic people, kindred to both the Avars and the Magyars. They entered Moldavia during the closing years of the tenth century. King Stephen (reigned 1001–1038) was forced to engage in many

FIG. 5—A street in Landvavásárhely, Göcsej.

struggles with them because of their inroads across the border into Transylvania. Finally, during the reigns of his successors the power of the Besenyők was broken because of stronger tribes attacking them from the rear, and they were glad to enter Hungary not as conquerers but as settlers. Many of this once warlike people were placed on the western frontier to ward off the encroachments of the Slavs. Here they amalgamated with the resident Avars, to form the present population of Göcsej and Hetés. Other colonies of the Besenyők were placed in little villages all over the country in sparsely populated parts such as were annually inundated by the Duna and the Tisza. In these scattered villages the Besenyők became completely fused with the Hungarian people about them. The only mark of the original colony is the name of Besenyő which still clings to most of these villages. One of the Besenyő villages, however, Besenyőtelek, in the county of Heves, still retains a great many of the old Besenyő beliefs.[31] In fact the folklore of the one isolated village is almost identical with that of Göcsej.

[31] There is a good description of the ethnology of the village of Besenyőtelek in the introduction to Berze Nagy János: Népmesék, Folk tales from the Counties of Heves and Jász-Nagykun-Szolnok, 1907.

The Palócz People[32]

Of all the isolated racial groups of present Hungary the most numerous is the Palócz, whose settlements comprise a large part of the counties of Hont, Nógrád, Gömör, Heves, and Borsod and include at least 150 villages with a population of over 150,000 souls. The study of the Palócz people is more confusing than that of other racial groups in the country, because the Palócz people themselves are ashamed of their name and of anything in speech, costume, or habits which distinguishes them from the rest of the Hungarian people. The reason for this is probably the practice of both the Hungarian stage and the Hungarian people of treating the Palócz as Hungary's most ridiculous figure: every proverb which refers to the Palócz describes him either as a clown or a boorish backwoodsman. When the great Hungarian novelist, Mikszáth Kálmán, portrayed in a kindly way the amiable features of the Palócz character, the people of the little Palócz village where he lived began to take pride in the name which the rest of their race have considered a reproach. As a result of this attitude on the part of the people themselves it is very hard to define the exact limits of the region. Parád, in the county of Heves, is considered the center of the Palócz country, because its people exhibit most strongly the Palócz characteristics in dress, speech, and customs. Yet the people of Parád are very quick to deny that they are Palócz people at all.

The word Palócz is supposed to be a corruption of the Slavic word Polowetz, which means "robber," and was originally given by the surrounding Slav peoples to marauding bands of Cumanians who, setting out from their home in what is now Russia or Poland, poured through the passes of the Carpathians on the north and occupied this region either at the time of the Magyar Conquest or shortly before it. In ancient Russian hymns of the eleventh century we find the "Palowcok" described as a fierce race which lived on the Don, Dneiper, and Volga Rivers. Anonymus describes the union of Kunok with Árpád's people at Kiev and their settlement in Hungary. It was from these that the people of the Sárköz sprang. Documents from the time of King Zsigmond, (1387–1437) show that even at that date the Pálócz Kunok, as they were called, did not know how to speak Hungarian. Even farther back than that, when King Salomon warred with St. László in 1086, he sought assistance from the Palócz people.[33]

If this hypothesis of the origin of the Palócz is correct—and it is now generally accepted by Hungarian scholars—then there have been

[32] The best description of the Palócz people is Malonyay, *op. cit.*, Vol. 5, 1922. In "Nógrád Vármegye Monographiája," 1911, pages 137–168 contain a good account of the Palócz people by Farkas Pál. In "Az Osztrák-Magyar Monarchia Irásban és Képben" there is in Volume 6 of the Hungarian section, 1900, a description of the Palócz people by Istvánffy Gyula. It covers pages 181–195. Istvánffy Gyula prepared two separate works, "Palócz Néprajzi Tanulmányok," 1894, and "Palócz Mesék a Fonóból," 1890. As showing the real Palócz character perhaps the best description is found in Mikszáth Kálmán's "A Jó Palóczok," 1915.

[33] Further data may be found in Malonyay, *op. cit.*, Vol. 5, pp. 12–14.

at least three distinct Cumanian (Kunok) settlements in Hungary: the earliest, that of the Palócz, coming from the north and completely distinct from the tide of Magyar invasion which soon followed it; the second, the small group of people found in the Sárköz, whose ancestors accompanied the invading Magyars; the third, coming from Moldavia where, after breaking the power of the Besenyők, they harassed Hungary for centuries but finally entered to settle in certain tracts

FIG. 6—Women of the Matyó. Young married women of Mezőkövesd, wearing the high-peaked *konty*.

in the Alföld set apart for them by the Hungarian kings. These Kunok of the Alföld, along with the kindred Jászok, preserve practically none of their primitive characteristics but have been assimilated to the Magyar people about them. Dr. Györffy, however, points out that before drainage and regulation of the flood lands, some 70 to 80 years ago, cattle were bred in the ancient manner by the Kun people.

THE MATYÓ PEOPLE[34]

In the southwestern corner of the county of Borsod lie the three communes of Mezőkövesd, Szent István, and Tard,[35] with a total Matyó population of about 23,560, of which about 17,800 are people of Mezőkövesd. Unlike the dying races of the Sárköz, the Ormánság,

[34] Istvánffy Gyula: A Matyó Nép Élete, 1897, gives a good description of the Matyó people, though I feel compelled to disagree with his view that they are merely a branch of the Palócz people. Garamszeghy Sándor: Matyó-lakodalom, gives a good outline of their wedding customs.

[35] The commune of Ecséd in the Hatvani district of Heves county is said by the people of neighboring villages to be Matyó. At present, however, there is no connection between this village and the three Matyó villages of Borsod county.

and the Csököly, the Matyó people are increasing faster than those of any other section of Hungary. The rapid increase has made it necessary for a large proportion of the people to seek their livelihood elsewhere during a great part of the year. As laborers they are employed on many of the extensive estates for the entire summer and autumn. Their travels, frequently from one end of the country to the other, bring them into close contact with every type of laborer in Hungary. Further, the Matyó people are devout Catholics and for the sake of pilgrimages will travel to any celebrated shrine in Hungary or beyond its borders. The handwork of the women of Mezőkövesd has become so widely renowned of late years that a market exists for it all over Europe; hence trade takes them as far as Vienna, Berlin, and Paris.

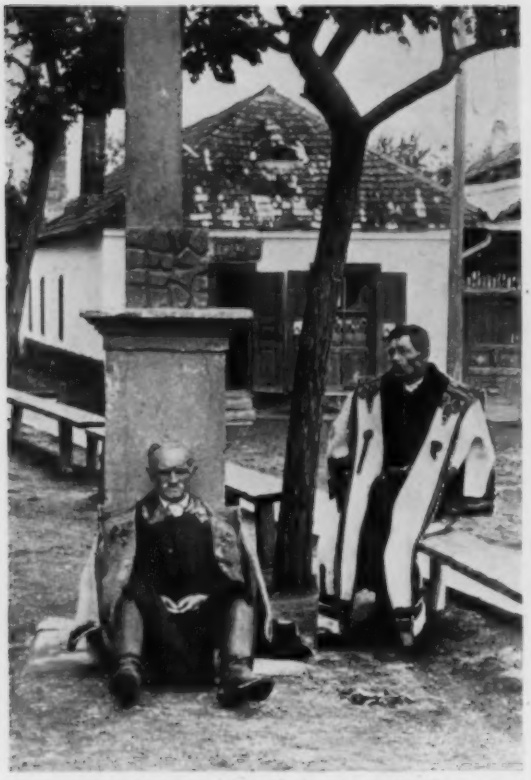

FIG. 7—Two old men of Mezőkövesd. A typical Matyó home in the background.

One would expect that this constant traveling and intercourse with other people would blot out the peculiar Matyó characteristics. On the contrary it seems merely to have intensified them. Wherever a Matyó travels, he associates only with other Matyó people. Matyó immigrants to our large American cities intermarry only with Matyós, even to the second and third generation. Though the Matyó does not retain his peculiar folk costume in America, still everywhere in Hungary he glories in the fact that he and his race dress differently from all other people. At the festival of St. Stephen in Budapest in 1925 I saw a group of a thousand Matyós all dressed in the ancient Matyó style. The most interesting thing about them was the pride with which they compared their own resplendent garments with the clothes of other people. In the same way they strive zealously to retain the old Matyó dialect: they do not wish to talk like ordinary

Hungarians. Childish as many of their old superstitions seem, they refuse to give them up, for are not these things also of the Matyó heritage? Thus their attitude contrasts with that of the Palócz.

The origin of the Matyó people has long been a disputed question among Hungarian scholars. They seem to have received the name of "Matyó" because they were, so they claim, the recipients of special favors from King Mátyás, who reigned from 1458 to 1490. Yet their history reaches back beyond his time. Some have argued that the Matyó people are a branch of the Palócz. In support of this they adduce the similarity between the Matyó and Palócz dialects and folk costumes. In the latter respect, however, the similarity is far from convincing. A careful investigation of the subject reveals a much more pronounced harmony with the Tatar groups—of Csököly and the Kalotaszeg—than with the Kun groups. Hence the most likely explanation of the origin of the Matyó people is that they are another broken remnant of the Tatar Invasion.[36]

FIG. 8—A young married couple of Mezőkövesd.

THE KALOTASZEG[37]

The six groups so far studied are to be found almost entirely within present Hungary. A few villages of Hetés belong now to Jugoslavia, and the northern Palócz villages have been ceded to Czechoslovakia.

[36] Istvánffy Gyula: A Matyó Nép Élete, pp. 119–122.
Idem: Az Osztrák-Magyar Monarchia, Vol. 6, p. 181.
[37] The best description of the Kalotaszeg is Malonyay, *op. cit.*, Vol. 1, 1907.

The three remaining groups are in Transylvania, Rumania, in territory entirely outside the borders of present Hungary. A part of one of these groups was even outside the borders of pre-war Hungary.

The Kalotaszeg is a region of 34 villages in the county of Kolozs (Rumanian, Cojocna) between Kolozsvár (Cluj) and Bánffyhunyad (Huedin). The people are descendants of Tatars but were settled in their present home by Prince George Rákóczi II about 1650.[38] They are stanch Protestants and resemble in many ways the people of the Sárköz. They employ much more color, however, in their folk costumes, for that seems to be a Tatar trait. Their dialect too is very similar to that of Csököly and the Matyó villages.

The Székely People[39]

The four southeastern counties of Transylvania are the home of the Székely race. While the Palócz group is the most numerous of present Hungary, it is relatively insignificant both in numbers and importance if compared with the Székely people. In the counties of Csik (Ciuc), Háromszék (Trei Scaune), Udvarhely (Odorheiu), and Maros Torda (Mures Turda) there are at least half a million of these people, a people not ashamed of their racial identity but glorying in it. Among all the Hungarian-speaking peoples there are no others so proud as these: this is partly due to the fact that this entire people was ennobled as a sort of peasant aristocracy. Although their possessions were small and they were compelled to work hard to eke out a living in rather barren country, still it was only for themselves that they worked. The ill effects of the feudal system in Hungary, with its sharp class distinction, were never found among them. The liberty-loving Székely could never tolerate either that he should serve others or that others should serve him. When tax-paying was the badge of serfdom, it became a proverb that the Székely would sooner die than pay taxes.

This proud race laid claim to descent from the heroes who fought under Attila. In poetic fashion they told how on the downfall of the great Hun Empire, a large body of the Huns remained in the Székely land, defending themselves from the enemies who surrounded them on all sides, while Csaba went back east—back to Asia—to summon their brethren, the Magyars, to assist them in winning back what had been lost. It is a romantic story, and the Székely people are very proud of it. Unfortunately historical documents are all against

[38] Wlislocki Henrik, in article "Kalotaszeg" in the Pallas Lexicon, Vol. 10, 1895, pp. 70–71. Dr. Jankó János in "Kalotaszeg Magyar Népe," one of the most valuable works on the region, takes the view that the Tatars settled here in the time of Rákóczi and mingled with the people previously living in these villages.

[39] For descriptions of the Székely people see Malonyay, *op. cit.*, Vol. 2, 1909, and "Az Osztrák-Magyar Monarchia Irásban és Képben," Hungarian section Vol. 7, 1901, pp. 261–279. This is written by Kozma Ferencz. See also Benedict de Jancsó: The Székelys, Budapest, 1921.

it but seem to show that the Hungarian kings of long ago set the Székely people on the eastern border that they might guard it at first from the Cumanians and later from the Rumanians. Hence their origin is very similar to that of the Göcsej people. At present it is generally assumed that the Székely people were of Besenyő origin, like those of Göcsej.[40] On the contrary, some scholars assert that the Székely dialect resembles more closely that of the Ormánság: hence an Avar origin is claimed. Might there not be some truth in the supposition of the people themselves that they are of Hunnish descent? This alone is proved: that the Székely people are not of Magyar ancestry but come of some closely related people.[41]

The Csángó People[42]

The Csángós, who received their name from the peculiar sibilating manner in which they pronounced certain Hungarian consonants,[43] are a widely scattered people. Their chief home is in the county of Brassó (Braşov) where they occupy seven villages—Bacsfalu, Türkös, Csernátfalu, Hosszufalu, Tatrang, Zajzon, and Pürkerecs: it is from this location in seven villages that they are called the Hétfalusi Csángók. Three other villages—Apácza, Krizba, and Brassó Ujfalu—also claim to be Csángó. Probably the only basis for their claim is that they too are Hungarian-speaking Lutherans in the Saxon county of Brassó. The lot of these Csángós was a hard one. They were settled here as guardsmen for the wealthy Saxon burghers of Brassó. They were almost forcibly converted from the Catholic to the Lutheran faith. Everything was done to make Germans of them; in spite of all they retained rigidly their Hungarian nationality and their Csángó customs. There are today 12,000 of this race in the seven villages, and it does not seem that their continued existence is threatened by any of the evil practices which are now depopulating some of these isolated groups.

In the time of Queen Maria Theresa many of the Csángós as well as Székelys emigrated to Bukovina and Moldavia.[44] In Bukovina they founded another group of seven Csángó villages, those of Andrásfalva, Boldogfalva, Hadikfalva, Istenfogadj, Istensegits, Józseffalva, and Magyarfalva. A more interesting situation awaited the colonists

[40] Gönczi, *op. cit.*, pp. 91–92.

[41] Sebestyén Gyula, former curator of the National Museum, in the article "Székelyek Eredete," The origin of the Székely People, in the Pallas Lexicon, Vol. 15, 1897, pp. 520–522.

[42] There is a good article on the Csángó people in Malonyay, *op. cit.*, Vol. 2. The introduction to Horger Antal's "Hétfalusi Csángó Népmesék," 1908, is one of the most authoritative works on this people.

[43] Simonyi Zsigmond in the Pallas Lexicon, Vol. 4, 1893, p. 609, notes that in most respects the Csángós of Brassó County have a dialect very similar to that of Moldavia.

[44] Dr. Györffy points out that the origin of the Moldavian Csángós is not yet cleared up. There are traces of them even at the time when the country belonged to the Kuns with whom they mingled. Some probably fled thither in the fifteenth century as Hussites from near the Drava. Perhaps Maria Theresa settled the Csángós of Bukovina from Csik County.

to Moldavia. In many counties, but especially in those of Bacau and Roman they came into contact with other Csángós who had been in Moldavia for centuries. Owing to absorption in the Rumanian population which surrounded them these older Csángó inhabitants had very largely lost their distinctive character. Contact with the newer immigrants helped them to persist in retaining the distinctive customs and language of the Csángós. There are at present about 100,000 of these Csángós in Moldavia.[45]

It is only since the cession of Bukovina and Transylvania to Rumania that the entire Csángó race has come under a single imperium. While Rumanian rule is said to be very galling to the Székely people, it is not greatly disliked by the Csángós. Even before the war Hungarian writers who studied the Csángós of the county of Brassó said that they considered Bucharest as their capital rather than Budapest. Many passes lead to Rumania. People having horses and carts were gladly received and well paid in the Rumanian kingdom. It was to Bucharest that a great many of them went to earn their livelihood.[46]

The Csángós are probably the broken remnants of the old Cumanian principality which for centuries occupied what later became Moldavia. This explanation would account for their presence in Moldavia and also for the similarity between their speech and that of the peoples of Palócz and Sárköz.

The interesting fact that these nine related but distinct groups have preserved ancestral customs and habits far better than the Magyars themselves is paralleled by the story of the Rechabites in the Book of Jeremiah. Doubtless the Rechabites were a nomadic tribe which had accompanied Israel at the conquest of Canaan. Centuries afterward when the prophet Jeremiah wished to find an example of the good customs of bygone days, he had to turn to these Rechabites who had remained in all things just like their fathers. So is it with these isolated races of Hungary. In speech, customs, and folk costumes they have remained like their fathers. Though not themselves descendants of the invading Magyars, they show us better than do the Magyars themselves how the ancestral Magyars lived, talked, and dressed.

[45] John Tatrosi: The Hungarians of Moldavia, p. 3.

[46] Malonyay comments in several places on this connection between the Csángó people and Bucharest. See also Horger, *op. cit.*, pp. 9–11.

CONTRASTS IN DAIRYING IN TWO DISSIMILAR AREAS OF THE UNITED STATES*

John Wesley Coulter

THE value of the peculiar contribution of geography to the solution of such problems as those discussed in this study of "environmental responses" lies in its treatment of the relationships existing between the difficulties of the people and the conditions under which they earn a living. Probably most geographers will agree that one of the objectives of economic geography is that of helping man to occupy successfully the difficult places of the earth by pointing out the lines along which adjustments should be made if he is to reap the full reward of his endeavor.

The present status of the dairying industry in the two contrasted areas under discussion has come about largely as the result of environmental factors, and the future course of development in each case must be along lines of adaptation to physical conditions, a knowledge of which is indispensable to a proper understanding of the situation. One of these contrasted areas is the coast district of San Luis Obispo County, southern California, and the other is Cook County, Illinois.

Climate and Feed

In the dairy-farming district along the coast of San Luis Obispo County natural pasturage is the main feed. The climate of this district, as of most of California, is one of winter rain and summer drought (Fig. 1). Vegetation grows luxuriantly during the rainy season and for a short period after its close: moisture rather than temperature is here the critical factor in plant growth. The mean seasonal precipitation at San Luis Obispo is about twenty-one inches, most of which comes between the beginning of December and the end of March. By midsummer the grass has dried up. The dry air and bright sunshine so effectually cure the pasturage that it preserves its nourishing qualities with little or no impairment, though the landscape becomes parched and brown. Most farmers grow enough oat hay to feed their cows for a few days before and after calving, because cows heavy with calf cannot forage successfully in the hilly country of this district (Fig. 2). Barley hay is raised as feed for horses. The oats and barley are sown on flat areas among the hills soon after

*The writer wishes to acknowledge courtesies extended by Mr. Parker Talbot, Farm Adviser, San Luis Obispo County, California, and by Mr. L. L. Heller, Farm Adviser, Cook County, Illinois, during field work in these areas.

the rainy season sets in, so that all available moisture may be turned to advantage. The tilled land on dairy farms is from one-seventh to one-tenth that devoted to natural pasture. Harvesting takes place from about the middle of July to the middle of August; there are no summer rains to interfere with operations. Some farmers thresh part of their grain, using a combined reaper and harvester to cut and thresh it in a single operation. This combination is possible because the

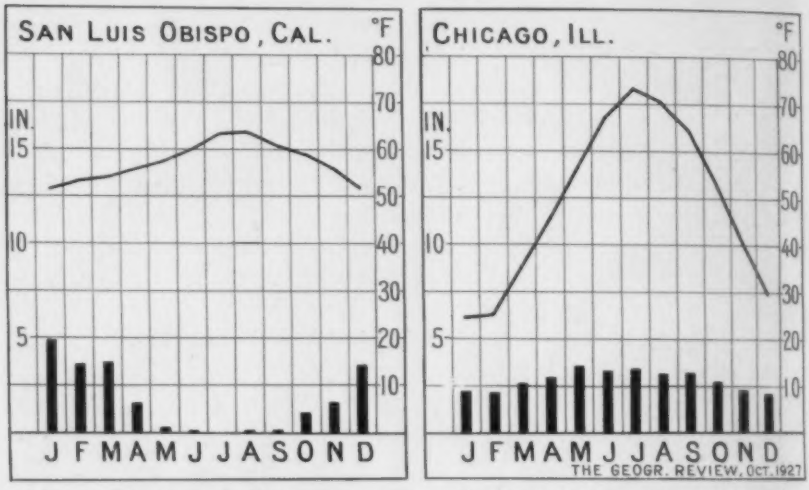

FIG. 1—Graphs of mean monthly temperature and rainfall at San Luis Obispo, Cal., and Chicago, Ill.

grain has been perfectly dried. Only the heads are cut off; cattle graze on the stubble. In most cases the grain is ground or rolled in a mill on the farm. There are a few dairy farms in this district on which a little alfalfa is raised by irrigation. Part of the land of these farms is on the flood plains of small creeks, from which water for irrigation is obtained by means of diversion dams or pumps. Within the last two or three years several dairymen have raised corn for ensilage, and it has been shown that this can be done without irrigation. The frequent occurrence of dense summer fogs along the coast helps to make this possible by inhibiting the evaporation of the abundant supply of moisture accumulated in the ground during the rainy season; unusually heavy fogs contribute moisture directly.

In Cook County, Illinois, fodder for dairy cattle consists for the most part of alfalfa hay, clover hay, and corn ensilage. Two crops of alfalfa are raised from the same seed without any moisture except that provided by the rainfall, much of which comes during the summer (Fig. 1). Temperature conditions, rather than moisture, here limit the growing season, which is about five months long. Snow commonly covers the ground much of the time during the months of January, February, and March. More work is required to harvest hay in the

continental climate of Cook County than in the dry, subtropical climate of San Luis Obispo County. Corn is raised in Cook County under conditions approaching optimum. Copious summer showers interrupt bright sunny weather. Temperatures both by day and by night are relatively high during the period of rapid growth of the corn plant. The land is slightly rolling, and much of the soil is rich. Farms are artificially drained, so that excessive moisture is carried off promptly. On 9 to 10 acres of land sufficient corn is raised to fill a silo of 100 tons capacity. A regular rotation of crops is practiced.

Type of Cow

The San Luis Obispo cattle are small and agile, able to climb about on the hilly pasture lands—in places very steep and rough. They can live for a time on a severely restricted amount of food and so are likely to survive an occasional shortage of grass due to an abnormally low rainfall or an unusually long dry season. Though the rough-coated "scrubs" having the foregoing characteristics yield relatively little milk and in many places would be regarded as inferior animals, dairymen here assert that they are the best kind to keep on these lands under present methods.

In Cook County 90 per cent of the dairy cattle either are Holsteins or have a predominating strain of Holstein blood. The Holstein breed originated in a region where a cool and moist climate induces a luxuriant growth of grass with a high percentage of water but a low percentage of nutritive value.[1] Holsteins give a larger quantity of milk than other improved dairy breeds, but the milk is relatively low in percentage of butter fat and in other solids.

Farm and Buildings

The average size of a dairy farm on the coast district of San Luis Obispo County is about 750 acres, which commonly will support about 75 dairy cows. The land is divided into separate fields by barbed wire fences. The day field is the largest grazing unit, and it comprises 300 to 400 acres. As a matter of convenience the night field, of 40 to 50 acres, is in most cases nearer to the dwelling house then the day field, preferably on relatively smooth land. Dairy cattle are outdoors the year round; and on cold, dark mornings of the rainy season it is specially desirable to be able to corral them easily and quickly. The "back field," of about 200 acres is farthest from the house; this is where heifers graze, and horses also graze there when not in regular use. A small field for cows about to calve is located within easy reach of hay. The hay and grain fields occupy 75 to 100 acres of land that

[1] V. C. Finch and O. E. Baker: Geography of the World's Agriculture, Government Printing Office, Washington, 1917, p. 119.

is nearly level and on which machinery can be used. The remaining tilled land on a farm is a small garden and orchard.

A dairy farm in Cook County comprises about 100 to 150 acres. On a 100-acre farm one would find that about 25 acres are used to raise corn, 30 acres for alfalfa or clover, and most of the remainder for pasture or grain. The number of dairy cows ranges from 20 to 30. They are kept in the barn during the winter and early spring, except for an hour or two each day. They also are driven in at night during cold weather at other times of year.

On a dairy farm in San Luis Obispo County the cow barn is the most conspicuous building (Fig. 2). The predominant type of horse barn is what is known locally as a "California barn," whose characteristic feature is its "winged sides," in one of which farm machinery and implements are kept. The dwelling house and the outbuildings are in most cases built of lumber brought by sea from the lumber-producing region of the northwestern states. The local timber, largely oak, is not suited for structural purposes. Practically all buildings have ordinary gable roofs.

In Cook County the most conspicuous building in the dairy farm group is the silo (Figs. 3 and 4), in which is stored corn ensilage; for convenience it is located close to the cow barn. The cow barn is smaller than that on a dairy farm in San Luis Obispo County and has two stories, the upper one being used for hay and the lower for cattle. It has a gable roof or in some cases a gambrel roof (Fig. 4). The milk house is somewhat smaller than that on a dairy farm on the coast district of San Luis Obispo County. Since milk is sold as whole milk, there is no need for a separator. Some dwelling houses and barns in Cook County are made of vitrified hollow tile from a local factory.

The Dairy Products

The mongrel stock kept on the dairy farms on the coast district of San Luis Obispo County produce a smaller quantity of milk per animal (something over 4000 pounds a year) than improved dairy breeds, and the milk is lower in percentage of butter fat. Cream is separated on the dairy farms and hauled to a creamery where butter is manufactured. The butter market is in Los Angeles, some two hundred miles south, to which the product is transported by truck and by train. During the rainy season, when pasturage is abundant and luxuriant, the quantity of milk produced reaches a maximum; and some whole milk is then sold, from which cheese is made. Towards the middle and end of the dry season the output of butter from the local creamery is small. The restricted supply of cream then comes largely either from those dairy farms on which some land is irrigated and where alfalfa is available or from farms where corn ensilage furnishes supplementary feed.

FIG. 2

FIG. 3

FIG. 4

FIG. 2—A dairy farm in the coast district of San Luis Obispo, Cal.: 1, dwelling house; 2, granary; 3, horse barn; 4, forge and tool house; 5, milk house; 6, mill; 7, cow barn; 8, hogpen (chicken house is not seen).

FIG. 3—A dairy farm in Cook County, Ill.: 1, dwelling house; 2, tool shed; 3, granary, 4, cow barn; 5, milk house; 6, barn for young stock; 7, silo; 8, chicken house and hog pen.

FIG. 4—A dairy farm in Cook County, Ill. The buildings are constructed of vitrified hollow tile.

In Cook County the average annual production of milk per cow is estimated at between 5000 and 6000 pounds. Milk is sold on a whole milk basis, and little attention is paid to butter fat content. The market is in Chicago, only a short distance away, to which 32 per cent of the daily milk supply is taken on trucks.[2]

Labor and Other Problems

A special labor problem confronts dairymen in both districts; in one case it is attributed largely to the isolation of the district, and in the other it is due to the proximity of a large city where wages are higher than dairymen can afford to pay. In the coast district of San Luis Obispo County the dairy farms are twenty to forty miles from "town" and are separated by the Santa Lucia Mountains from a "through railroad." San Luis Obispo is the railway shipping point for the dairy produce of this district. In Cook County the dairy farms are so near to a large metropolis that a hired laborer soon finds he can better his income by getting work in the city. Dairy farmers try to get laborers from distant rural sections; but, after working a year or two on a dairy farm, a laborer is likely to move to Chicago.

On many farms in the coast district of San Luis Obispo County labor is hired only for the season when work is heavy—at the beginning of the rainy season. In some cases dairymen who operate tractors have fitted them with headlights so that plowing may be continued after dark. Work days are 14 to 16 hours long at this season.

On dairy farms in Cook County, cows freshen at intervals throughout the year. Work is distributed during the entire twelve months, but is more onerous during the harvest season. The milk supply must be maintained, for consumption in the city is steady throughout the year. On some dairy farms all the work is done by the farmer and his family. Where hired labor is necessary, it is retained permanently.

The most serious problems confronting dairymen in the coast district of San Luis Obispo County are the improvement of the breed of stock and the provision of supplementary feed in adequate amount. The chief problem at present engaging the attention of dairy farmers in Cook County is that of freeing their herds from tuberculosis, which is associated with indoor conditions. The future prosperity of the industry here will be dependent upon the maintenance of healthy herds.

[2] M. M. Quaife: "Chicago Highways, Old and New" (Chicago, 1923), reviewed in the *Geogr. Rev.*, Vol. 16, 1926, p. 137.

THE MLANJE MOUNTAINS OF NYASALAND

F. Dixey

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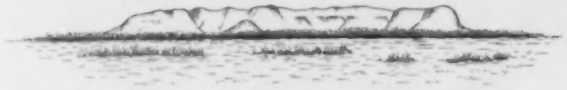

FIG. 1—The Mlanje Mountains as seen from Lake Chilwa.

THE traveler visiting Nyasaland by rail obtains his first good view of the Mlanje Mountains in clear weather from near Chiromo, from which they are seen to rise above the head of the broad, shallow Ruo Valley at a distance of about 45 miles (Fig. 2). Subsequently, near Luchenza, the railway passes within 15 miles of the mountains and affords probably the best point for a comprehensive view. The mountains rise up boldly from the southeastern corner of the Shire Highlands, where they constitute a more or less rectangular mass about twelve miles across, of which the four sides face the four cardinal points. The Shire Highlands lie at an altitude of about 2100 feet. The fine precipices that limit the mountains on almost all sides attain to heights of about 6000 feet, where they form the outer edges of a number of small plateaus that rest upon the flanks of the mass. Behind the plateaus rise numerous high peaks and ridges; while most of these reach altitudes of 8000 to 9000 feet, the highest peak, known as Mlanje Peak, is nearly 10,000 feet in height.

The mountains rise so steeply above the surrounding country that climatic differences are sharply marked. On the Shire Highlands the year is divided into a rainy period extending from the end of November to the end of March and a dry period occupying the remainder of the year, with a cool period following the rains. On the mountains the rains are much more prolonged and are apt to extend intermittently all through the year. On the Shire Highlands the annual rainfall usually ranges from 40 to 50 inches; about the southwestern foot of the mountains approaches 70 inches; on Lichenya Plateau, 4000 feet above, is about 110 inches. The heavy rainfall is an economic asset to Nyasaland in that it has given rise to a valuable tea-growing industry. Moreover the abundant waters of the Ruo and its tributaries, to which it gives birth, not only enable the Shire below Chiromo to function as a river in dry periods but also form potential sources of water power of considerable magnitude. During the cool season frosts and hail are frequently experienced, and ice forms on open pools to a

thickness of fully half an inch; moreover, heavy falls of snow occur at wide intervals, as in 1926 for example. In the hot season, during the few months preceding the rains, the cool climate of the mountains affords welcome relief from the heat of the surrounding country.

Soils and Forests

The soils of the mountains are generally poor, largely because of heavy rainfall and rapid erosion. The rolling grassy uplands that constitute the plateaus are underlain by a black soil only a few inches in thickness, and this rests upon bauxitic clay and weathered rock to depths of 20 to 40 feet. In the intervening densely-wooded ravines and gullies, however, a much greater thickness of soil has accumulated. The grasslands afford grazing for cattle from August to December, and consequently, since grazing becomes more and more difficult on the plains below as the dry season advances, cattle are then not infrequently driven up onto the mountains for pasture. Amidst the grass grow certain small plants with thick gray leaves and yellow flowers which natives used formerly to burn for salt extracted from the ashes.

The steeper mountain slopes above the plateaus usually consist of masses of bare rock, but occasionally they support scattered tufts of grass or a few shrubs; the "drawf cypress," possibly a degenerate form of the Mlanje cypress, also occurs on these slopes. In sheltered places on the upper levels, even within a few hundred feet of the main peaks, a number of bogs persist throughout the year.

On the backs of the ridges, as well as in the cols and on the peaks, the rock is deeply fissured along the joints and in many places is split into innumerable large rectangular blocks, usually rounded at angles and edges: the fissures separating these blocks may be as much as 30 feet deep and 10 feet wide at the top, and they are usually choked with dense scrub. It is this condition that makes the ascent of Mlanje Peak so difficult and exploration of the higher altitudes so strenuous.

The small forests of Mlanje constitute almost the only remaining tracts of really heavy timber forest in Nyasaland. For the most part they consist of patches of Mlanje cypress (*Widdringtonia whytei*) in the valleys and ravines on the higher slopes and plateaus at elevations of 4000 to 7000 feet. The Mlanje cypress is not found in any other part of Nyasaland, and the only other region in which it is known to exist naturally is Chirinda Mountain in the Melsetter district of Southern Rhodesia, where a few small patches of the tree lie at altitudes of 5000 to 7000 feet. At Mlanje the tree frequently attains splendid dimensions, and, in pockets of good deep soil, trees with clean stems up to about 50 feet and measuring 4 to 5 feet in diameter at breast height are occasionally seen. The wood is of a pale reddish color, very durable, and easily worked; it is of great importance

locally because it resists the attacks of white ants (termites). *Podocarpus milanjiana*, a tree belonging to the yew family and said to be identical with the "yellowwood" of South Africa, is found sparsely scattered throughout the cypress and other woods of the mountains; it occurs also at the higher elevations in Kenya Colony and Uganda. The trees are of small dimensions, however, and rarely exceed a foot in diameter at breast height. Tree ferns are also of common occurrence on the mountains.

There is ample evidence to show that the area of forest land was once much greater than it is at present. For example, stumps of trees may often be seen in the grasslands far removed from any existing forest; since many of these stumps are in a much-burned condition, there is reason to believe that the reduction of the forest area has been largely brought about by the action of uncontrolled bush fires of the past. But in recent years every effort has been made to protect the remaining forest from fire. It is of interest that, although the forest itself is of moist type, the grassland formation that has largely replaced it is of xerophytic type; this is doubtless due to greatly increased exposure to sun and wind which has followed upon the removal of the forest covering from the soil and the loss of the organic matter contained in it. Wherever the soil has been disturbed by the wear and tear of footpaths and the furrowing of wild pigs, or unduly exposed in consequence of frequent grass fires, it is subject to rapid erosion leading to the formation of deep gullies, and such soils as persist on the steeper slopes are generally coarse and gravelly.[1] Accordingly, the difficulties of reforestation tend to increase as time goes on.

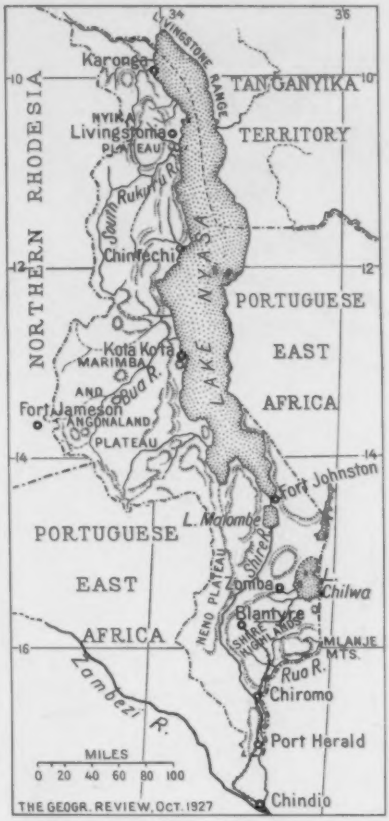

FIG. 2—Sketch map of Nyasaland showing the situation of the Mlanje Mountains. Scale 1: 8,500,000.

There is usually but little game to be seen on the mountains; klipspringer and bush buck are present in small numbers, wild pigs

[1] F. Dixey, J. B. Clements, A. J. W. Hornby: The Destruction of Vegetation and Its Relation to Climate, Water Supply, and Soil Fertility, *Nyasaland Protectorate Dept. Agric. Bull. No. 1 of 1924*, Zomba.

FIG. 3

FIG. 4

FIG. 3—Mlanje Peak from the south at an altitude of 9000 feet. Note the sparse vegetation and the rocky nature of the country.

FIG. 4—The northern end of Lichenya Plateau, showing smooth grassland with patches of cypress. The surface is underlain by an extensive deposit of bauxite.

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FIG. 5

FIG. 6

FIG. 5—The southern scarp of the Mlanje Mountains with the gorges of the Lujiri, Ruo, and Little Ruo. Manene Peak in the distance.

FIG. 6—Lichenya Gorge and part of the plateau with the Forester's cottage in the foreground. The gorge is lined with cypress. In the distance a fine waterfall.

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are numerous and very destructive, and leopards are fairly common; during the dry season lions sometimes appear on the plateaus, whither they have been driven by the bush and grass fires of the low country around the foot of the mountains. The bird life is of special interest because, on account of the greater elevation and the colder climate, it shows important differences from that of the Shire Highlands but resembles that of other elevated masses like Zomba Plateau and Chiradzulu.

Apart from the small staff maintained by the Forestry Department and the European visitors of the hot season, the Mlanje Mountains are uninhabited. This is due to the severity of the climatic conditions. When natives accompany Europeans who have occasion to spend some weeks on the mountains during the cold season, special precautions have to be taken to provide them with food, clothing, and shelter, since they are otherwise apt to die from exposure. Local natives state that formerly certain light-skinned people dwelt in the mountains, and Sir Harry Johnston, in his "British Central Africa," refers to native statements as to the recent existence there of "a dwarf race of light yellow complexion" with the physical characters of the Bushman-Hottentot.[2]

The Mountains are accessible only by means of several steep footpaths that follow the less difficult ascents, and, although a track runs from Lichenya to Tuchila Plateau, communication between one part of the mountains and another can usually be made only by walking or climbing over the open country.

The Bauxite Deposits

The Mlanje Mountains have recently attracted attention because of the discovery there of large resources of bauxite, the principal source of aluminium. The occurrence was first recognized by the Geological Survey in September, 1924,[3] and subsequent investigation has shown the deposits to be of great potential value.

The bauxite occurs in the form of superficial deposits on the little plateaus disposed around the flanks of the massif. The principal deposit rests on Lichenya Plateau, although others exist sufficiently near to be worked in conjunction with the main deposit. The Lichenya deposit extends over an area of not less than two square miles; over much of this area it ranges from 15 to 30 feet in depth, and in several places depths exceeding 40 feet have been proved. If an average depth of only 7 feet of workable ore be assumed, the deposit contains not less than 20,000,000 tons of bauxite.

As exposed at the surface of the ground the ore forms hard, platy, porous masses that vary in color from buff to brick red. At a depth

[2] Sir H. H. Johnston: British Central Africa, London, 1897, p. 53.

[3] F. Dixey: Bauxite Deposits in Nyasaland, *Mining Mag.*, Vol. 33, 1925, pp. 201–205. London.

of one or two feet it becomes fairly soft, so that it could be excavated easily and at small cost. In composition it is comparable with the red varieties of French and Dalmatian bauxite. Investigations made at the Imperial Institute[4] show that the deposit contains ore suitable for the production of aluminium, aluminous cements, and refractories.

As regards exploitation it should be noted that the deposits stand on the western side of the Mlanje Mountains at an altitude of 6000 to 6400 feet above sea level, and they are cut off from the plain at the foot of the mountains by a precipitous scarp nearly 4000 feet in height. The foot of the mountains is about 15 miles by road from the Shire Highlands Railway at Luchenza Station, which is nearly 330 miles from the port of Beira. A road for vehicular traffic from Lichenya Plateau down to the plain could only be constructed at excessive cost, and consequently some form of aerial cable transport would appear to offer the best means of communication.

The deposits could be worked without difficulty by means of open cuttings; and, owing to the low gradients available, transport from one part of the plateau to another could easily be effected.

Since ample water or other power is needed it is fortunate that great water power resources exist in the immediate vicinity of the Lichenya deposit. The Lichenya River and its tributaries rise on or near the plateau, and within a few miles they fall through a vertical height of more than 3000 feet; moreover, along the inner margin of the plateau falls of several hundred feet may easily be obtained, and even where the volumes of water considered are small, the available head is very great. Finally, the configuration of many of the upland valleys is such that storage or service reservoirs could be constructed at reasonable cost if found necessary; the more important streams are perennial, however; and, as has already been pointed out, the rainfall on the mountains is heavy.

Labor would have to be imported from other districts, and special provision would be necessary in order to protect the natives during the cold wet weather. From the European point of view, however, the climate is quite a healthful one.

The only important deposits of bauxite hitherto recorded from Africa are those of the Gold Coast, which have been discovered by the Geological Survey within recent years.[5] In view of the fact that the market for aluminium goods in East and South Africa in addition to the other parts of the continent is one of great and increasing importance, it is therefore of interest that the deposit at Mlanje is the only one known on the eastern side of Africa that offers any possibility of commercial development.

[4] *Bull. Imp. Inst.*, Vol. 24, 1926, pp. 731–736.

[5] A. E. Kitson: Outline of the Mineral and Water-Power Resources of the Gold Coast, British West Africa, with Hints on Prospecting, *Gold Coast Geol. Survey, Bull. No. 1*, 1924. The deposits are large and occur chiefly on the summits of the highest flat-topped mountains.

Land Forms of the Mlanje Mountains

The Mlanje Mountains consist essentially of a large syenitic intrusion[6] or intrusions, the erosion of which in the course of ages has given rise to the mountains as we see them today. In spite of the descriptions of early travelers and the beliefs locally entertained, no evidence of former volcanic activity has yet been observed upon the mountains. As yet no evidence of former glaciation has been observed on Mlanje in spite of the elevation. Kenya, on the equator, exhibits traces of glaciation at 10,000, and Kilimanjaro, 3° S., at 11,800 feet; and Mlanje lies 16° S. Probably this is due to the relatively small size of the mass. The present land forms are due to normal erosion.

The Plateaus

There occur upon the mountains a number of relatively small platforms, generally known as plateaus, that may take the form either of wide benches on the flanks of the massif or of broad depressions that form parts of ancient valleys of great size. They lie at elevations of 6000 to 6800 feet above sea level, or nearly 4000 feet above the base of the mountains, and in general constitute rolling grassy uplands intersected by deep wooded ravines and gullies.

The best known example of these platforms is Lichenya Plateau, which attains a total length of several miles and forms the head of a broad shallow valley much dissected by a number of tributary streams; it is half encircled by a wide plateau of slightly higher elevation that terminates abruptly on its outer side in a line of bold precipices. About half a dozen European cottages, occupied in the hot season, lie scattered over the grassy downs of the plateau.

The Tuchila Plateau is a much dissected sloping bench on the northern side of the massif; it is several miles in length, about a mile in width, and made up principally of a succession of long parallel spurs running out from the mountain side. These spurs are separated by deep, densely-wooded ravines and at their outer ends are terminated by bold precipices hundreds of feet in height; the backs of these spurs, of which that surmounted by the Forester's Cottage may be regarded as typical, are broad, gently convex, and overlain by thick turf. The Ruo Plateau, which stands at the head of the Little Ruo Valley, is so difficult of access that it is but rarely visited; to some extent it resembles Lichenya Plateau in general form, but it is of smaller size.

In addition to these plateaus may be mentioned that of the Ruo Valley, which is situated between the Little Ruo Plateau and the Tuchila Plateaus; at the upper end it is uneven, bleak, and rocky, but

[6] An orthoclase-hornblende-syenite: with the exception of a varying content of quartz, causing the mass sometimes to approach a potash-granite in composition, the rock maintains a fairly uniform character over the whole of the area described.

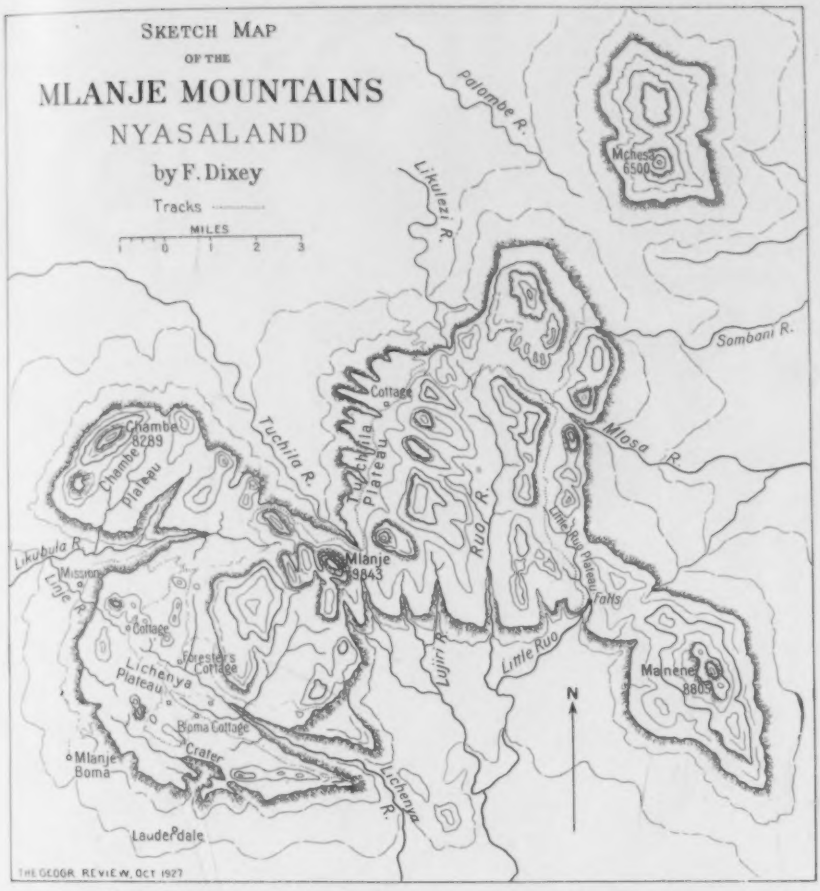

FIG. 7—Sketch map of the Mlanje Mountains. For position see Figure 2.

at the lower end, near the magnificent gorge by which the Ruo descends to the plains, it consists of numerous sharply-divided ridges and spurs similar to those of Tuchila Plateau. North of the Little Ruo Plateau and separated from it by a wide gap is another valley with a broad uneven floor upon which the Mlosa River rises; extending northwards from it and continuous at the farther end with a wide elevated shelf that overlooks the Fort Lister Gap is the Sombani Valley, the floor of which is occupied by several broad grassy ridges. A well-defined plateau extends also from the foot of Chambe Peak around the head of the Likubula Valley, while another small platform runs along the flanks of Manene Peak.

THE VALLEYS

Practically all the upland valleys are abruptly truncated upon reaching the sides of the massif, where they overhang bold precipices

that may be as much as 3000 feet in height; moreover, some of the larger valleys, such as the Ruo Valley for example, are truncated at their upper ends also. As may be expected, the larger rivers incise magnificent gorges into their valley floors as they approach the precipices; such gorges, although frequently very narrow, sometimes attain to depths of many hundreds of feet, and the rivers, now actively engaged in extending the gorges headwards, plunge into the depths in one or two splendid leaps. While well-developed tributary gorges also exist, many of the smaller streams have not yet succeeded in cutting notches of appreciable size into the crests of the various precipices; such streams accordingly disappear into the depths at one bound and thus constitute the fine waterfalls that are so conspicuous a feature of the scenery of Mlanje towards the end of the rainy season. In some cases the larger gorges, while maintaining their narrow cleft-like form at their upper ends, open out considerably where they abut on to the precipitous mountain sides.

At least one of the larger valleys that is widely opened at the lower end, namely the Likubula, does not abut directly onto the mountain side but rather onto a well-defined shelf that swings around the flanks of the massif. It is into this widely opened floor and the shelf beyond that the modern Likubula River has incised its lower gorge. The shelf is only about 1600 feet above the modern plain that extends around the foot of the mountains and is thus of much later date than that forming Tuchila Plateau.

A well-defined valley-in-valley form characterizes the upland valleys. The larger valleys that contain the various "plateaus" described above show signs of a former mature or late-mature development; their broad floors are often more than a mile across, and their sides exceed a thousand feet in height. In any typical case the old floor of the valley has been carved into a series of wide steps or rock terraces that fall successively down to the level of the river; in many cases also there extends upwards along the bottom of the valley from the edge of the precipice a deep, narrow gorge. Such features are beautifully developed within the Mlosa and Ruo Valleys for example.

The valley-in-valley structure of Lichenya Plateau has been controlled to some extent by the varying hardness of the enclosing rocks, which consist in the upper part of 60 to 70 feet of relatively soft detritus and the decomposition products of the underlying formation, while in the lower part they consist of hard unaltered syenite. A late rejuvenation has enabled the streams easily and quickly to cut down their beds to these resistant rocks, but the gorges incised into them lower downstream are taking a relatively long time to work upstream to the plateau area. To this slow retrogression is due the preservation of the grassy downs that form such a pleasant attribute of the little plateau.

FIG. 8

FIG. 9

FIG. 8—The "Crater," an erosional form of the Mlanje Mountains, and part of the western scarp.
FIG. 9—Transportation presents difficulties in the Mlanje Mountains.

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The Precipitous Mountain Sides

The Mlanje Mountains are limited on all sides by bold precipitous scarps or steep rocky slopes which rise abruptly to a height of several thousand feet above the surrounding plain. Erosion is proceeding around the flanks of the massif at a very considerable rate, and it is greatly assisted by exfoliation and by the systems of vertical joints

Fig. 10—The Mlosa Valley at the point at which the side is breached and the river captured by a little gorge working up from the main eastern scarp.

in the rocks. Headward erosion along joints or other lines of weakness running at right angles to the scarps has given rise to deep narrow clefts that run far back into the mountain sides. When a cleft of this type meets another line of weakness running transversely to it, that is to say more or less parallel with the face of the scarp, there arises a tendency to development of a deep caldron-like hollow. An excellent example is that behind Lauderdale Estate known as the "Crater." The view presented upon looking down into the Crater is very impressive. The walls rise vertically to a height of more than 3000 feet: the floor supports a dense forest vegetation that is watered by the spray of numerous streams which finally escape to the outer world by way of a deep narrow gorge. When headward erosion of this type proceeds along parallel lines, it sometimes gives rise to enormous buttresses that project boldly from the adjacent mass. Good examples may be seen behind Lauderdale Estate in the vicinity of the Crater.

An important effect of the rapid retrogression of the main scarps is the diversion of the waters of upland valleys into new channels that run directly down the mountain sides. The modern scarps bear no

special relation to the upland valleys; they may run parallel with them or truncate them at any angle. Where a scarp runs parallel with and at no great distance from an upland valley the lateral erosion of the one may so far exceed the downward erosion of the other that the face of the scarp may ultimately encroach upon the side of the valley. If this process continues the outer side of the valley will be lowered more and more until the stream normally flowing down the

FIG. 11—A patch of cypress showing the usual sharp division between the woodland and the grassland.

valley will be diverted to the scarp, whence it will begin to fall down the mountain side and erode a new channel for itself. When this action takes place, the erosion of the old valley floor above the point of capture will be increased, whereas that below will be retarded. These features are well exemplified at the point where the Mlosa suddenly departs from its valley by means of a narrow gorge and then plunges down the eastern flank of the mountains.

PHYSICAL HISTORY OF THE MOUNTAINS

The evolution of the present forms of the Mlanje Mountains has proceeded by four major stages. The evidence for the first stage lies in the pronounced accordance of summit levels that becomes obvious when the mountain mass as a whole is observed from a distance. During this stage the area considered formed but a part of a much larger area, which was ultimately reduced to a region of low relief.

The second stage was introduced by an uplift or series of uplifts amounting to about 3000 feet, as a result of which erosion again

became active. The total uplift doubtless occupied a long period of time, but certain benches that can still be traced high up along the valley sides indicate that it was interrupted by one or more periods of quiescence. As this stage advanced the mountains were reduced in area to something less than that of the present day, and they became surrounded by a plain similar to that which, at a much lower level, even now surrounds them. The mountains then rose as broad ridges to a height of about 3000 feet above wide, flat-bottomed valleys and the adjacent extensive plain onto which they opened out. These valleys still remain, at least in part, as the upland valleys of the present mountains, while the outer plain now exists only as the broad shelves that appear at intervals practically around the Mlanje massif.

Towards the end of the second stage considerable deposits of bauxite accumulated upon the broad floors of the intermontane valleys and upon the adjacent plains by the alteration of the underlying syenitic and other rocks. While most of these deposits have been almost entirely swept away as a result of subsequent erosion, some of them, as described earlier in this paper, are still preserved in part.

The second stage was brought to an end by the initiation of a period of intermittent uplift during the earlier pauses of which additional bauxitization took place on the lower levels. To this third stage are ascribed the rock terraces observable on the broad floors of the larger upland valleys. Terraces indicating two distinct pauses can usually be seen, but traces of others can also be distinguished, particularly in the Ruo and Mlosa Valleys. Subsequently to the formation of these terraces a southerly tilting of the area took place. From the manner in which the terrace steps have been carved one within the other, with greatly increased gradients or even cliffs leading successively downwards from the higher to the lower levels, it may be inferred that the sea or other falling base level of the time was situated at a considerable distance, although the tilting observed may indicate that a certain amount of faulting also took place.

To the fourth stage are due the grander and better known features in the relief of the Mlanje Mountains. This stage introduced the great differential movements that raised the upland region of the massif, developed during the preceding three stages, nearly 4000 feet above the surrounding country. It appears more than probable that these movements were due to faulting and, moreover, that they were related to the earlier fractures of the Rift Valley system.

This late faulting of the Mlanje massif took place in two or more main stages that were separated by rather a long pause or pauses, during which the larger rivers had time to open out their lower courses through the mountains into flat-bottomed valleys of considerable width. Subsequent faulting left these valley plains, together with strips of the adjoining lowlands, hanging at an elevation of about

1600 feet above the modern plain. Additional evidence of repeated faulting is afforded by certain low steps running along the flank of the mountain mass, such as those upon which the Mlanje Boma and Mlanje Mission stand, and also by the little Chole Plateau that rises out of the plain a few miles from the western foot of the mountains.

The present magnificent scarps that limit the Mlanje Mountains on nearly all sides and rise as almost vertical precipices several thousand feet above the plain do not, in most cases at least, represent the actual fault faces, since erosion subsequent to the faulting has worn

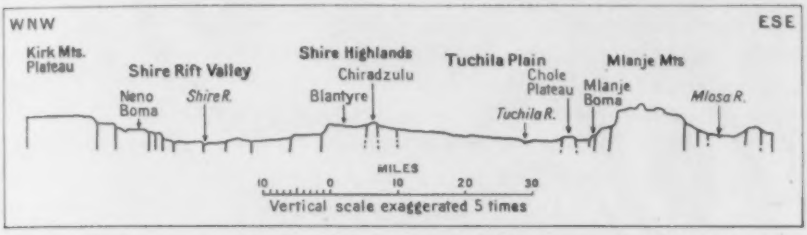

FIG. 12—Section across southern Nyasaland from the Kirk Mountains to the Mlanje Mountains. (After Fig. 2, p. 124, *Geogr. Journ.*, Vol. 68, 1926.)

them back in places to distances of fully half a mile. There does not appear to have been additional faulting within Recent times, although earth tremors are of fairly frequent occurrence; but the work of denudation of the mountains is being carried on at a great rate owing to the striking relief of the area, to the frequency with which it has been subjected to rejuvenation, and also to the high rainfall.

THE MLANJE MOUNTAINS AND THE GREAT RIFT VALLEY

The broad depression running along the western foot of the Mlanje Mountains may be regarded as a branch of the Great Rift Valley as developed in this part of Africa; and formerly, before its diversion into the Shire Rift as a result of renewed faulting, the drainage from Lake Nyasa escaped by way of this depression and the Lower Ruo Valley. In a northerly direction this branch includes Lake Chilwa and communicates with another that forms the head of the Lujenda Valley.[7]

An east-and-west section across the southern part of Nyasaland and the Mlanje Mountains shows the depression west of the mountains continued by a gradual upward slope that gives rise to the Shire Highlands, beyond which is the deep, step-faulted trough, occupied by the Shire River, that forms the main branch of the Rift in this region (see Fig. 12).

It has already been shown that on the western side of the Mlanje Mountains overlooking this branch of the rift there are several plat-

[7] See F. Dixey: The Nyasaland Section of the Great Rift Valley, *Geogr. Journ.*, Vol. 68, 1926, pp. 117–140.

forms of erosion ranging from a few hundred to 4000 feet in height; these platforms, although doubtless due to faulting in the first instance, belong to pauses that were sufficiently long for complete accordance to develop between them and the valleys with which they communicated. It is regarded as probable that the younger of these platforms are related to those earlier stages in the development of the Rift Valley during which Lake Nyasa stood at 700 to 1000 feet above its present level; an examination of the lacustrine sediments fringing the northwestern shores of the lake shows that these movements date back into pre-Pliocene, probably Oligocene, times and that they have continued intermittently almost down to the present day. The older and higher platforms on the other hand, such as those upon which are developed the bauxite deposits already referred to, are evidently of much greater age; it may therefore be concluded that before the rifting dated by the Nyasan sediments there had been yet earlier faulting of similar intermittent type preceded by a wide general uplift.

LAPIÉS IN HAWAIIAN BASALTS

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CVIJIĆ[1] has given American geographers an excellent description and explanation of lapiés, a detail of limestone erosion familiar to the geographers and geologists of central Europe. They are also known by the German names "Karren" and "Schratten," and are "surfaces covered by a network of furrows and crests" formed by chemical erosion of the purer sorts of limestone. The channels range in general from 1½ to 3 feet in depth; but some are 6 to 10 feet, and extreme examples may be as much as 30 to 40 feet deep. The ridges, if broad, may be roughened by furrows of a smaller order of magnitude. In uniform rocks the lapiés tend to parallelism; but irregularities are caused by bedding, concretions, fissures, joints, etc. Sloping surfaces are most favorable; but the forms may be developed on vertical, though never on horizontal, surfaces. Vegetation and soil impede their formation.

Lapiés go through a series of characteristic stages, or a cycle, which begins immediately after the laying bare of a limestone surface. In youth the channels are shallow and are separated by low, sharp ridges. In maturity the greatest ruggedness is reached, the sides of the ridges have the steepest possible inclination, and the channels have their maximum depth. In old age the ridges are destroyed by being undercut and break off as blocks of fantastic shapes. The end of the cycle is characterized by heaps of limestone blocks resting on an uneven surface, often covered by residual clays and vegetation. The lapiés may be rejuvenated one or more times until the channels reach the level of permanent ground water.

Small-Scale Forms

Two types of surfaces that in many respects resemble the lapiés of limestone regions have been developed on the basalts of the Island of Oahu, Territory of Hawaii. These forms are also found on others of the Hawaiian Islands but in only a few instances that I can cite from my own observations. In the one type the feature is developed on a small scale. It consists of a fluting of rock surfaces, the distances between ridge crests being in general from two to six inches. The depth from crest to trough varies from an inch to ten inches. There

[1] Jovan Cvijić: The Evolution of Lapiés, A Study in Karst Physiography, *Geogr. Rev.*, Vol. 14, 1924, pp. 26–49.

is little variation of size from top to bottom of any one groove or ridge. Boulders in the upper part of Kalihi valley, back of the western part of the city of Honolulu, show such flutings. The best example, so far as my observations go, is on the southwestern headland of Waimea Bay, on the northeast coast of Oahu. These are illustrated in Figures 1 and 2, in which the pocket knife gives the scale. The rock is basalt of an unusually thick and dense flow. The edge of the flow has been undermined by wave erosion, its massiveness enabling it to resist erosion rather effectively so that it forms a distinct structural bench. The dense texture makes it almost impervious in contrast to most Hawaiian basalts. A permanently wet spot exists on the surface of this flow and, presumably, is the discharge of a small body of perched ground water. The water escapes by trickling down over the edge or through the few vertical joints and has grooved them. The stream has, with rare exceptions, always been so thin that molecular attraction has held it in contact with the rock surface and greatly retarded its rate of fall. As a consequence powers of mechanical erosion have been negligible; but, on the other hand, whatever solvent action there may have been has been continuous and unceasing. Basalts, since they are rich in iron, calcium, and magnesium, are relatively susceptible to chemical attack, and it appears that the perpetually trickling streamlets have been able to dissolve channels. Once a channel had been started along some fortuitous course it would concentrate and direct the movement of the water, resulting in further deepening of the channel. The continual movement of the water, though gentle, would be adequate to the removal not only of the dissolved matter but perhaps

FIG. 1—Lapiés-like flutings on dense olivine basalt, southwestern headland of Waimea Bay, northwest coast of Oahu.

FIG. 2

FIG. 3

FIG. 2—Another view of flutings at Waimea Bay.
FIG. 3—Waimanalo cliffs, southeastern end of the northeast shore of Oahu, illustrating the major type of lapiés-like flutings.

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also of some of the decomposed mineral grains in a mechanical way. This type is rare.

Large-Scale Forms

The second or major type of Hawaiian lapiés is on a far grander scale. It is best developed on the cliffs back of Waimanalo at the eastern end of the northeast coast of Oahu. Less striking flutings are found in Lualualei and Makaha valleys on the leeward side of Oahu, in Iao and Waikapu valleys on the Island of Maui, and elsewhere. The flutings at Waimanalo (see Fig. 3) extend vertically 1600 or 1700 feet, that is from the top of the cliffs, 2200 to 2500 feet above sea level, down to the tops of alluvial slopes 600 to 800 feet above sea level. At Waimanalo the ridges in general are spaced 150 to 200 feet apart. It is impossible to make a satisfactory photograph of the detail of these flutings because of the dense undergrowth and the rough terrane. The few that I have examined have walls that are 75° to 85° from the horizontal. They are covered with a remarkably continuous blanket of vegetation, largely grasses, ferns, and vines. At the head of each fluting there are one or more vertical streaks a foot to a yard wide almost devoid of vegetation, down which water trickles most of the time. The unusual aspect of these flutings leads one to apply unusual terms to them. Locally the term "vertical valleys," which is due to Vaughan MacCaughey, is sometimes applied to the grooves, and "washboard topography" to the ensemble.

The drainage area tributary to each of the flutings back of Waimanalo is very small because the divide is close to the top of the cliff. It is of the order of seven acres for each channel. The rainfall is of the order of 100 inches a year, which would give a mean discharge of water of about one-twelfth of a cubic foot per second if there were no loss by evaporation or by absorption. The Waimanalo cliff faces a little east of north, which is favorable for "catching" the orographic rains from the northeast trade wind. The run-off is relatively uniform. The small but persistent run-off from these collecting basins supplies a gentle, steady flow of water, enough to trickle continually down the bare strip at the back of the furrow and slowly to deepen it. Molecular adhesion causes the small stream to adhere to the rock as a thin film. The water cannot break away, it cannot fall freely and develop a high velocity, and it is therefore not a strong agent of mechanical erosion. The work of erosion must be done chiefly by solution, just as in the small-scale flutings first described. So far as my observations go there are no lapiés-like flutings on any intermediate scale.

Hydrographic Similarities in Basalt and Limestone

From the preceding discussion it appears that the slightly soluble Hawaiian basalts, under the requisite conditions of steep initial

topography and small but continuous flow of water, tend to develop details of erosion which are remarkably similar to the lapiés details of limestone regions and which are similarly due in large part to chemical erosion rather than to mechanical erosion. We may note that the term "erosion" is here modified by the attribute "chemical," instead of the usual "mechanical." "Chemical" usually refers to weathering or decomposition: here, however, "chemical erosion" seems appropriate.

Another analogy between the basalts of Hawaii and the limestones of karst regions may be noted; namely, that in both the ground-water table is remarkably low. This is almost proverbial of limestone regions. The force of this statement with respect to Hawaiian basalts may be seen from the fact that those who work on problems of ground-water geology in Hawaii speak habitually of the *elevation* of the water table above sea level and not of the *depth* of the water table below the ground surface. In Hawaii the water table is normally close to sea level. The basalts are in general extremely pervious to water, as are many limestones. Thus basalt regions, like many limestone regions, are characterized by a scarcity of surface streams. Many miles of the "Government Road" on the slopes of Mauna Loa need no culverts as the water from rains sinks underground promptly instead of collecting to form streams.

NOTES ON THE TORNGAT REGION OF NORTHERN LABRADOR

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Harvard University

FIG. 1—The Labrador Coast. Looking north in Ryan's Bay.

ANY account of northern Labrador must be prefaced by the statement that it still remains "one of the least known parts of North America."[1] Especially is this true of the mountainous country called the Torngat region. This system emerges from the sea along the last 250 miles of the coast as perpendicular cliffs attaining occasionally 3000 and even 3500 feet, but dwarfed by the heights beyond. The rocks are as old as any exposed on the surface of the earth, being part of the great Canadian shield, but they have been so consistently raised that in terms of the erosion cycle these alpine mountains are still in maturity. The plateau is everywhere dissected by streams which have thus far eroded deep, narrow valleys. The peaks rise to 5000 and 6000 feet, and at least one of these probably reaches 7000 feet, in which case this system would exhibit the highest land anywhere in the eastern part of North America. During the last advance of the ice those valleys under 2500 feet were subjected to glaciation and as a result, running in from the sea and winding away among the hills for from twenty to fifty miles, are some fifty of the grandest fiords of our earth. The vegetation is dwarfed and typically arctic, growing mainly in the valley bottoms, trees being found only in the very southernmost portion of the region: soil is scarce—conditions that make the Torngats perfect for geological study.

The writer visited the region during the summer of 1926 on the expedition planned and commanded by Columbus Iselin 2nd, who

[1] Compare A. P. Coleman: Northeastern Part of Labrador, and New Quebec, *Canada Geol. Survey Memoir 124*, Ottawa, 1921. Other admirable reports on parts of this region are Dr. W. T. Grenfell's well known book "Labrador," new and revised edit., New York, 1922; E. B. Delabarre: Report of the Brown-Harvard Expedition to Nachvak, Labrador, in the Year 1900, *Bull. Geogr. Soc. of Philadelphia*, Vol. 3, 1902, pp. 65–212; R. A. Daly: The Geology of the Northeast Coast of Labrador, *Bull. Museum of Comp. Zoöl. at Harvard College*, Vol. 38 (Geol. Ser. Vol. 5), 1902, pp. 203–270.

had built especially for the trip the 37-ton auxiliary schooner *Chance* and was under the advisorship of Dr. Henry Bigelow of Harvard University. The expedition was mainly concerned with the study of the upper Labrador Current[2] and the fauna and flora of the Torngats.

The Southern Torngat Region

The region of Cape Mugford marks the southernmost portion of the Torngats. The mountains rise 2000–3500 feet directly from the sea. For the lower 800 feet they are of gray granitic rock; above, all is dark, horizontally stratified rock of sedimentary origin. They present a most striking appearance, the more so after the relatively low land of southern Labrador. Our first work in this region was in Saglek Bay. From Cape Mugford to Saglek Bay bare, snowcapped mountains border the coast. On August 8 we entered this fiord to the south of Kikkertaksoak Island and ran along the southern shore under cliffs rising 1000 feet out of the sea. Cutting these cliffs are many great vertical and horizontal dikes of black intrusive basaltic rock. Above 2000 feet the mountains were covered by patches of snow and ice. Warm blasts of wind swept down from the hills—a chinook effect described by Coleman.[3] Although the temperature on the water is cool, the bare granite rock gets very hot after a day of scorching sun. Just beyond the cliffs at the entrance is a broad S-shaped trough from about 1200 feet down to the water, apparently scooped out and smoothed by a small entering glacier. Several small icebergs were afloat in the bay;

FIG. 2—Map of northeastern Labrador. The northernmost part is based on Bernhard Hantsch's map (1908) accompanying his "Beiträge zur Kenntnis des nordöstlichsten Labradors," *Mitt. Vereins für Erdkunde, Dresden*, Vol. 8, 1909, pp. 168–229, and Vol. 9, 1910, pp. 245–320. The remainder of the coast is based on the map accompanying Coleman's report (see footnote 1). Additions and corrections have been made by the author on the basis of the 1926 expedition. Scale of map approximately 1:4,000,000.

[2] See the paper by C. O. Iselin: A Study of the Northern Part of the Labrador Current, *Bull. Natl. Research Council No. 61 (= Trans. Amer. Geophys. Union, 1927)*, Washington, 1927, pp. 217–222.

[3] *Op. cit.*, p. 11.

but, as we had pushed through fields of hundreds of huge bergs for 500 miles, they bothered us not at all. A high snow-covered and cloud-mantled range fills the northwest. After sailing in for five miles we saw two Newfoundland fishing vessels anchored in a cove on Kikkertaksoak Island. Myriads of mosquitoes, locally known as "flies," swarmed about. The fishermen reported salmon in the bay; this was interesting because, while they run in the rivers of southern Labrador, heretofore they had not been recorded anywhere near so far north. Later, on leaving the bay, our skipper was presented with a twelve-pound cock salmon. These fishermen are interested only in cod, which they salt down.

The fiord is several miles wide and very deep with walls about 1200 feet high. Many brooks dash out from under snow patches upon the land and cascade down over the cliffs. Twelve miles west the bay branches into two arms each about a mile wide. At this point, beside a stream entering from the north, was an Eskimo encampment of five tents, but seemingly with enough people to fill twice that number, for there were many children. We later learned that the Eskimos were camping on the best trout stream in the bay. They live on trout during the summer, catching the fish in nets. All of them appeared well fed and cheerful. Some thirty miles from the sea navigation ends, and the glacial valley is occupied by a meandering river. Because of the great depth of the fiord it is necessary to anchor on the river delta.

Attempt to Reach the Top of the Plateau

One of the objectives of the trip was to make collections of the fauna and flora of the unglaciated regions of the Torngats—the country above 2000 feet. The Long Range of Newfoundland and the Shickshock Mountains of Gaspé, which were not touched during the last advance of the ice, are characterized by endemic species of western affiliations mingled with the arctic-alpine forms from the postglacial. The Torngats are known to be similar: as Professor Fernald says, "Our knowledge of the flora of the high mountains of northeastern Labrador is very incomplete. . . . Of course, the more generally dispersed arctic types are there; but the Torngat region at once stands apart from the rest of the Labrador Peninsula on account of the cordilleran species isolated there."[4]

There being no way out of the valley where we were anchored, a party went in to find a place of possible ascent; but no such possibility existed within the first twelve miles, nor was anything promising seen ahead. The débris weathered from the cliffs has formed great

[4] M. L. Fernald: Persistence of Plants in Unglaciated Areas of Boreal America, *Memoirs Gray Herbarium of Harvard Univ.*, No. 2; *Memoirs Amer. Acad. of Arts and Sci.*, Vol. 15, 1924–26, pp. 237–342; reference on p. 316.

cones of rotten rock which sometimes reach one third of the distance to the top of the cliff, and boulders of all sizes are constantly tumbling down from the heights. Tramping over the broken rock fragments was difficult. Caribou tracks were plentiful; ducks were there, and every cliff seemed to have its pair of hawks; arctic trout (Greenland

FIG. 3

FIG. 4

FIG. 3—Lee Falls (south wall of Nachvak) one mile distant. Nachvak River in foreground.
FIG. 4—Schooner *Chance* anchored on delta at head of northwest arm of Saglek Bay.

charr) were spawning in the stream. One of our fishermen caught a twelve-pound trout that measured forty inches. An old Eskimo village was seen on a wave-cut terrace twenty-five feet above the present level of the bay. There were several works of stone about two feet by seven feet, with a stone-paved base, walls four feet high, and no roof.

Early on August 13 we started north for Nachvak Bay. All night we had been held up by heavy fog. The charts for these waters are crude and inadequate, and icebergs make sailing dangerous by night unless the skies are clear. Leaving Saglek we made our way past the range called Mt. Blow-Me-Down, rising just behind the coast wall to a height of 3500 feet, impressive with its snow-filled valleys and rugged contours. On the cliff walls facing the sea is

FIG. 5

FIG. 6

FIG. 7

FIG. 5—Northwest arm of Saglek Fiord; cliffs 1000 feet, ascent impossible.
FIG. 6—Dikes of basalt. Coast just north of Saglek.
FIG. 7—In Nachvak, looking southwest from anchorage two miles in the fiord, 7 a. m.

FIG. 8

FIG. 9

FIG. 10

FIG. 8—Nachvak. Chance Lake looking east.
FIG. 9—Nachvak. Typical Torngat topography; ten miles northwest of Chance Lake (2800 feet).
FIG. 10—Nachvak. Eight miles northwest of Chance Lake at 2500 feet. Fog above.

FIG. 11

FIG. 12

FIG. 13

FIG. 11—"Four Peaks," *c.* 7000 feet, from one mile northeast of region of the Iron Strand.
FIG. 12—Three of "Four Peaks" (left center). Entrance to Ryan's Bay at right.
FIG. 13—Coast just north of Ryan's Bay.

the best display of dikes seen by us in the whole Torngat region. Broad vertical bands of black basalt traverse the granite masses in many places, some of them 100–200 feet wide and one at least 300 feet wide. These dikes run straight back through the hills of Mt. Blow-Me-Down and can be plainly seen for miles as black ridges.

Nachvak Bay

The next day we sailed into beautiful Nachvak Bay, probably the best known of the northernmost fiords on the Labrador coast. At the right of the entrance Mt. Razorback rises 3500 feet out of the water, maintaining its height for four miles as a serrate ridge. Easily noted from sixty miles out at sea, it is a fine landmark for incoming vessels. Nachvak Fiord averages about a mile in width with 1000-foot hill cliffs on either side. Strong gusts of wind draw down through the great trench, and sailing folk must be cautious. Ten miles inland the fiord branches. Thus far the cliffs are not so steep-sided as those of Saglek. Several miles inland the northern arm makes an abrupt turn to the west, and after six miles it again turns to the northwest. About thirty miles from the seacoast a large delta has been built completely across the fiord. Here we anchored.

On the Plateau

It was now decided to make a definite attempt to get out of the fiord valley onto the upland. We carried our gear and a motor skiff about a quarter-mile across the delta to the upper end of the fiord and motored to the end of this body of water, which we called Chance Lake. It is eight miles long and a little less than a mile wide. The cliff walls are here perpendicular, like those of Saglek, and 1000 feet high. Hanging valleys, marking the entrance of smaller glaciers, come in high up on these walls. At the end of Chance Lake we left the skiff and waded up the river for a mile, an easier route than through the tangle of willows and alders. Falls cascade over the cliffs about every half mile. Two miles from the lake the valley floor is filled by a 250-foot flat bank of alluvium, the delta of the river at a time when the land was lower than it now is. As the land has gradually risen, the river has cut its way down through the old delta to the rock floor. At this point, about thirty-five miles west of the coast, we made our way out of the valley over the very steep 900-foot north wall. Upon reaching the top of the cliff we found ourselves surrounded on three sides by mountains 4000–5000 feet high. A supporting party of four men departed to help establish a base camp at 3000 feet for the two men who were to work there for two weeks while the vessel went offshore to take a cross section of the continental shelf.

We worked back to a region some forty-five miles west of the coast at 3000 feet but could see nothing of promise. The permanent snow line was at 3000 feet, so that the unglaciated portions were not producing life—this year at any rate. There was no vegetation except mosses and lichens. We experienced incessant rain, fog, and cold wind. Clouds enveloped everything above 5000 feet. There were innumerable snowdrifts and several cirques, but the glaciers in them did not appear to be active. We had entertained thoughts of working west so that we could at least see Ungava Bay, but this was impossible with the little time available and the rough country encountered. The mountains rose to four, five, and perhaps six thousand feet, none of them named or located on the maps.

The Northern Waters

Returned to the vessel we sailed out one hundred miles offshore to make a cross section of the continental shelf, taking water samples and temperatures at various depths. The strongest part of the Labrador Current is about twenty miles offshore. It runs about two knots and is apparently a surface current, because on our way south in perfectly calm weather we drifted twice as fast as the large and deep icebergs. It is evident from the massive block-like form of the icebergs in northern waters that the smaller and more weathered bergs which get south into the shipping lanes are at least one year older, having been frozen in over a winter. Sailing back to the shore on a bright clear day we saw the high peaks of the land where we had been enveloped in clouds for three days.

Our course from that time on was in waters which are not only uncharted and unsounded but which are practically unknown except for the fact that they are infested with hundreds of shoals and islands. It may be noted that this is the only time a vessel has sailed along northern Labrador without a pilot. Had we taken one it would have been impossible for us to cover the territory we did, because they sail from island to island and will not sail at night. We worked north past the Region of the Iron Strand and the Four Peaks. The latter comprise what is supposed to be the highest land in Labrador. As they are several miles back of the coast, it is difficult to get a correct measure of their height. They are estimated to be about 7000 feet.[5] The true height will not be known until some one arrives on the scene well appointed for enduring hardship and with time to spare, and the climbs will not be easy: the Peaks in the upper 3000 feet appear to be steep-sided pyramids.

At the mouth of Ryan's Bay were two Newfoundland fishing vessels. This is their farthest north. The Ryan's Bay fiord has

[5] Elevations under 3000 feet were measured with an altometer; those above were estimated. The writer, however, is of the opinion that 7000 feet is a conservative estimate for the Four Peaks.

heretofore been unexplored; we stayed here two days. The sides are steep hills rather than cliffs. On the north bank is the characteristic evidence of elevation along the Labrador coast, here taking the form of a fine series of wave-cut terraces reaching to a height of 300 feet above sea level. This fiord is not so deep as Saglek and Nachvak. It is a mile wide, runs four miles northwest, turns abruptly, and runs fifteen miles southwest where it ends with a high delta 200 feet above sea level. The meandering river has cut its way down through this alluvium to the rock bottom. A party worked back twenty miles from the bay, passing two large lakes six and eight miles in. They were stopped by a large range running north and south and forming the divide between Ungava Bay and the Atlantic. Raised beaches were observed most of the way, and several deserted Eskimo camps eight miles from the bay. We noted a glacier on the south side of the bay about halfway in. The cirque was about one-third full of ice, and the fall as typical as those of the glaciers of Mt. Rainier, showing distinctly the much crevassed blue-gray ice and with distinct *Bergschrund*. Mountains about this region seem to be 4000–6000 feet; our plans for ascent, however, were spoiled by thick fog. Although this region is only thirty-five miles north of Nachvak there is a distinct difference in the flora.

On August 26 we continued north, bound for Ekortiarsuk, a fiord never before entered by white man as far as the record goes. Sailing was now conducted with great care. Vessels bound for Hudson Bay sail twenty miles offshore to clear the shoal-infested waters of this north coast. We had always to have a man aloft and two men constantly sounding with lead and line. Although the water is clear, luxuriant growth of kelps makes the ledges invisible. Strong squalls from the northwest were frequent.

Fog held us up in northern Eclipse Harbor a day and a half. We sailed into Ekortiarsuk on August 28. Shoal water and many islands at the entrance of the bay explained why no vessel had ever been inside. After working northwest through the broad bay for two miles, we came to the entrance of the fiord proper. It runs southwest for twelve miles, then west for six miles, where it ends in a broad bay a mile wide, very shallow compared with the heads of fiords farther south, and with side walls not so sheer. A branch fiord enters the main one from the west about eight miles from the entrance. There are many nubbles or low hills along the shore, a feature not so characteristic of other bays. Fog prevented us from gaining any conception of the top of the land save that it appeared to be much lower than about Nachvak and Ryan's Bay. Passing to the north from Saglek to Nachvak, to Ryan's, and to Ekortiarsuk there is an interesting gradation in the fiords from steep cliffs and very deep water to gently sloping hills and shallow water.

When ready to start south we were again held up four days with heavy fogs. We had hardly been prepared for the amount of fog experienced throughout our expedition in view of the reports of previous visitors. Rain fell every day, but only occasionally did we have heavy storms of long duration. Above 3000 feet the precipitation was always snow. Prevailing winds in September are supposed to be strong and enduring westerlies, but we experienced only two light westerlies. The temperature at sea level ranged from 33° to 50° F. During the night it was usually about 34° F.

In all of the fiords we made extensive collections of plant and animal life, which are now being worked up.[6] Our oceanographical data, it is hoped, will prove to be of aid to the International Ice Patrol.

[6] A paper by the writer, "Interesting Plants of Northern Labrador," appeared in the April, 1927, number of *Rhodora*.

THE LABRADOR BOUNDARY DECISION

Hon. Sir Patrick T. McGrath, K. B. E.
President of the Legislative Council
of Newfoundland

ON March 1, 1927, the Judicial Committee of the Imperial Privy Council, the Tribunal in London which had been adjudicating the dispute between Canada and Newfoundland regarding the boundary of their respective jurisdictions in Labrador, rendered its decision. The Canadian claim was, in effect, that the "coast of Labrador" extended from Cape Chidley in the north to the bay of Blanc Sablon[1] in the southwest a mile inland from the high water level. The Newfoundland claim was that the "coast" should be the area from the Atlantic to "a line drawn due north from Anse Sablon as far as the 52 degree of North latitude, and should be traced from thence northwards to Cape Chidley along the crest of the watershed of the rivers flowing into the Atlantic Ocean." The decision of the Judicial Committee was to the effect that Newfoundland had, in the main, made out its case and was entitled to the ownership of the Atlantic watershed of the Labrador Peninsula, though two trifling diversions in favor of Canada were included in the judgment.

The dispute had been at issue for nearly twenty-five years, counting from the time preliminary litigation in the civil courts began, but as a diplomatic problem it extended back another twenty-five years, because the United States Government, in 1874, sought and secured from Canada a pronouncement with respect to it. Historically, the roots of this problem may be said to go back to the early days of the discovery of the region we now know as Canada, and, in order to appreciate how the dispute arose, it is necessary to refer briefly to a few landmarks in the early history of North America.

The Island of Newfoundland

In 1497 John Cabot sailed to Newfoundland from the west coast of England, an enterprise inspired to develop the British Navy, which marked the reign of Henry VII and was the keynote of British policy in relation to Newfoundland until the nineteenth century. During the years between 1497 and 1583 Portuguese and Basque fishermen and others from Normandy and Brittany resorted to the Newfoundland coast often in greater numbers than the English. In

[1] The form Blanc Sablon has generally replaced Ance, or Anse, Sablon for the last hundred years.

1583 Sir Humphrey Gilbert obtained a commission from Queen Elizabeth as Governor of the Island and a large grant of land there. In Hakluyt's words, "he was the first of our nation that carried people to erect an habitation and government in these northerly countries of America." But his attempt at colonization failed, and he himself perished on the return journey.

In 1610 a further attempt at colonization was made by Guy's Association, which obtained a Royal Charter from James I granting them territory between Cape St. Mary and Cape Bonavista. Under the protection of this Charter, John Guy of Bristol settled in Conception Bay, issuing decrees as Governor. In 1698 the system of fishing admirals was introduced. The first captain to arrive from England at any harbor for the spring was *ipso facto* admiral for the season, the second vice admiral, and the third rear admiral. The admirals performed not only executive but judicial functions, a right of appeal being reserved to the officer commanding the convoy of the King's ships.

Canada and New France

Meantime, in 1534, Cartier had made his first voyage to the Bay des Chaleurs and Gaspé. In the next year occurs the first mention of "Canada," the river now known as the St. Lawrence being referred to as the Grand River Hochelaga, "the waterway of Canada." In 1603 came Champlain, who can fairly be called the founder of New France. In 1608 he formed a settlement at Quebec and later at Three Rivers. In 1641, shortly before his death, a third settlement was formed at Montreal. These three sparsely populated settlements—there were only two hundred persons in Quebec in 1641—formed the districts upon which the French organization was based, and the plans made by General Monckton and Lord Amherst after the fall of Quebec in 1759 show that the same division was maintained by the British until Quebec was made into a province by the Royal Proclamation of 1763.

The Hudson's Bay Company

During the latter half of the sixteenth century Frobisher saw Hudson Strait, and Davis crossed its mouth and sailed down the coast of Labrador to the fifty-second degree of north latitude, landing at what are now known as Davis Inlet and Hamilton Inlet. In 1610 Hudson sailed into Hudson Bay.

In 1670 the Hudson's Bay Company obtained from Charles II a royal charter giving them sole rights of trade and commerce of all those seas, straits, bays, rivers, lakes, creeks, and sounds in whatsoever latitude they should be, that lie within the entrance of Hudson Strait, together with all the lands and territories upon the countries, coasts, and confines of the seas, etc., as foresaid, that were not actually pos-

sessed by or granted to any of His Majesty's subjects or possessed by the subjects of any other Christian Prince or State. The Company were also granted the proprietorship of the territories so described and the full right and power to govern such territories.

FIG. 1—Reproduction on a reduced scale of a portion of the inset "A New Map of Hudson's Bay and Labrador" on Mitchell's "Map of the British and French Dominions in North America," 1755.

It is unnecessary to trace in detail the history of the conflicts which followed between the British established under the authority of this Charter on the shores of Hudson Bay and the French who were making their way north to Hudson Bay from New France. In 1697, by the Treaty of Ryswick, the French obtained from Great Britain a cession of the territories bordering on Hudson Bay. But war soon broke out again, and in 1713, by the Treaty of Utrecht, France restored to Britain "the bay and streights of Hudson, together with all lands, seas, seacoast, rivers, and places situate in the said bay and streights, and which belonged thereunto, no tracts of land or sea being excepted which are at present possessed by the subjects of France." The Treaty further provided for both sides to determine by Commissaries, to be forthwith named by each, the limits which were to be fixed between

the said Bay of Hudson and the places appertaining to the French, which limits both the British and French subjects should be wholly forbidden to pass over or thereby to go to each other by sea or by land. The same Commissaries were also to describe and settle in like manner the boundaries between the other British and French colonies in those parts. Commissaries were duly appointed, and proposals and counter-proposals were made; but no definite decision was ever reached.

The Treaty of Utrecht further declared Newfoundland to belong in exclusive sovereignty to Great Britain but reserved fishing rights to the French between Cape Bonavista and Cape Rich.

The Position on the Labrador Peninsula in 1763

The Labrador peninsula connotes all the area, some 511,000 square miles in all, east of a line joining James Bay and the St. Lawrence River. Prior to 1763 the position was that the only territories on the Labrador peninsula subject to the British Crown were those granted to or acquired by the Hudson's Bay Company under their Charter of 1670 and that, though the boundaries of those territories were not definitely ascertained, they did not extend anywhere (save possibly in respect of the area between Cape Chidley and Cape Grimington) farther into the interior than the height of land, which formed their boundary in 1857.

In 1763 the Labrador peninsula was regarded as of importance almost solely on account of the fisheries carried on on the north shore of the Gulf of St. Lawrence, mainly for whale, sea cow (walrus), and seals; in the Strait of Belle Isle, and each year a little farther north of this strait, principally for cod; and on the rivers along all the extent of the coast mentioned, for salmon. Before the Treaty of Paris, 1763, the French made grants of territory along the northern shore of the Gulf of St. Lawrence to French subjects; few if any of such grants extended more than four leagues into the interior, and but one of them seems to have extended farther east than Belle Isle. Traffic with the native inhabitants in fur and hunting in the interior were interests not wholly overlooked by the French and English, but they were of subsidiary importance compared with the fishing. The seaboard of the country was bleak and uninviting, swampy and unsuitable for cultivation, and highly inaccessible.

The native population was small and migratory. Eskimos dwelt along the coast, particularly north of the Strait of Belle Isle (there are now no Eskimos south of Hamilton Inlet). Of the Indian tribes the Montagnais, the "Mountaineers," lived farther inland principally south of the Hamilton River, with their main hunting grounds near the North West River, though they hunted on both sides of the height

of land; the Nascopies occupied the central portion of the area south of Hudson Strait. The numbers of these native inhabitants have varied little since 1763 and now are probably between two thousand and four thousand in all. In the area now claimed by the Newfoundland Government no Europeans were settled. Even today the interior country is largely unknown, and between the Saguenay River and Cape Chidley there are no settlements out of sight of sea or river water; while even in the western part of Canadian Labrador, between Natashquan and the Saguenay, apart from the most rudimentary agriculture and a pulp mill established some ten years ago at Seven Islands, there is no industry except fishing and furring.

Labrador Attached to Newfoundland

Shortly after the Treaty of Paris had been signed in 1763 the eastern section of Labrador, from the entrance of Hudson Strait to the St. John River, which enters the sea near the western end of Anticosti Island, was attached to the Governorship of Newfoundland, and after that the English authorities set to work to dispose of the rest of the conquered territory. A Royal Proclamation was issued, creating four colonies—Quebec, East Florida, and West Florida on the mainland, and Grenada in the West Indies—and reserving for the use of the Indians, who had been on terms of amity with Britain, the remainder of the vast French empire which had now come into English hands. In this Proclamation it was set out that:

> To the end that the open and free fishery of our subjects may be extended to and carried on upon the coast of Labrador and the adjacent islands, we have thought fit, with the advice of our said Privy Council, to put all that Coast from the river St. John's to Hudson's Streights, together with the islands of Anticosti and the Madelaine and all other smaller islands lying upon the said coast, under the care and inspection of our Governor of Newfoundland.

In these two varying descriptions, one attaching the territory to the Governorship of Newfoundland, without any qualifications, and the other placing it under the care and inspection of the Governor of Newfoundland, "in the order that the free and open fishery of our subjects may be carried on," will be found the bone of contention between the Governments, as will be shown later. In 1774, after the Labrador territory had been eleven years part of Newfoundland, the whole of it was reannexed to Quebec, though there is evidence, from the discussion attending the passage of the statute which so transferred it, that the intention of the English Government was merely to return to Quebec the section from Belle Isle Strait westward. The reason for this was that the fisheries and fur-trading in that area were carried on by people residing on the seaboard; whereas these industries on the Atlantic front were prosecuted mainly by fishing vessels manned by crews from the British Isles direct, or with Newfoundland as an

advanced base. In 1809, the ascendency of the latter having increased meanwhile, the whole territory was again transferred to Newfoundland, as the experience of thirty-five years had shown that it was impossible for the Government of Quebec to control the region—indeed, the only effective control was exercised by the Commander of the Naval Squadron which protected the fishing fleet, he also being the Governor of Newfoundland. Finally, in 1825, an arrangement was made whereby the area between the St. John River and Ance Sablon, at the western extremity of Belle Isle Strait, was reannexed to Quebec, the remainder being left to Newfoundland, which still retains it.

The Growth of Quebec Province

The Royal Proclamation of October 7, 1763, which created the Colony or Province of Quebec, fixed its boundaries thus:

> Bounded on the Labrador Coast by the river St. John, and from thence by a line drawn from the head of that river, through the lake St. John, to the south end of the Lake Nipissim; from whence the said line, crossing the river St. Lawrence, and the Lake Champlain in forty-five degrees of north latitude, passes along the high lands which divide the rivers that empty themselves into the said river St. Lawrence, from those which fall into the sea . . .

In 1774 the Province was enlarged. The western boundary was carried north to strike that of the Hudson's Bay Company, and, as the whole of "the Coast of Labrador," whatever that meant, was reannexed to Quebec, it would seem to follow that the whole of the peninsula east and north became part of Quebec to the watershed draining into Hudson Bay, while the territory beyond the crest of the terrain belonged to the Hudson's Bay Company. Then it would equally seem to follow that in 1809 this same area was passed back to Newfoundland and that she retained it in 1825, except for the section between Ance Sablon and the St. John River.

In 1867 came an important development consummated in 1869. The Hudson's Bay Company sold to the Canadian Government all its territory reserving only certain choice sections in and about towns and along roads. In 1898 Quebec secured an extension of her northern boundary from the Laurentian watershed to the line of the East Main and Hamilton Rivers, the one debouching into Hudson Bay on its eastern side, and the other debouching into the Atlantic; and in the Canadian statute effecting this enlargement the boundary was carried along the center of the Hamilton River to a point near Rigolet, and thence southward to Blanc Sablon. Finally, in 1912, the remaining portion of what was previously known as the Ungava District, from the line of the East Main and Hamilton Rivers northward to Hudson Strait, was also added to the Province of Quebec, and its eastern boundary was declared to be the western boundary of the territory lawfully in the possession of Newfoundland.

The Boundary Issue Arises

The reason for this last development was that between 1898 and 1912 the two countries had come to grips over the region. Newfoundland assuming, as always, that the territory was hers, began in the nineties to issue grants of land for mineral and timber development;

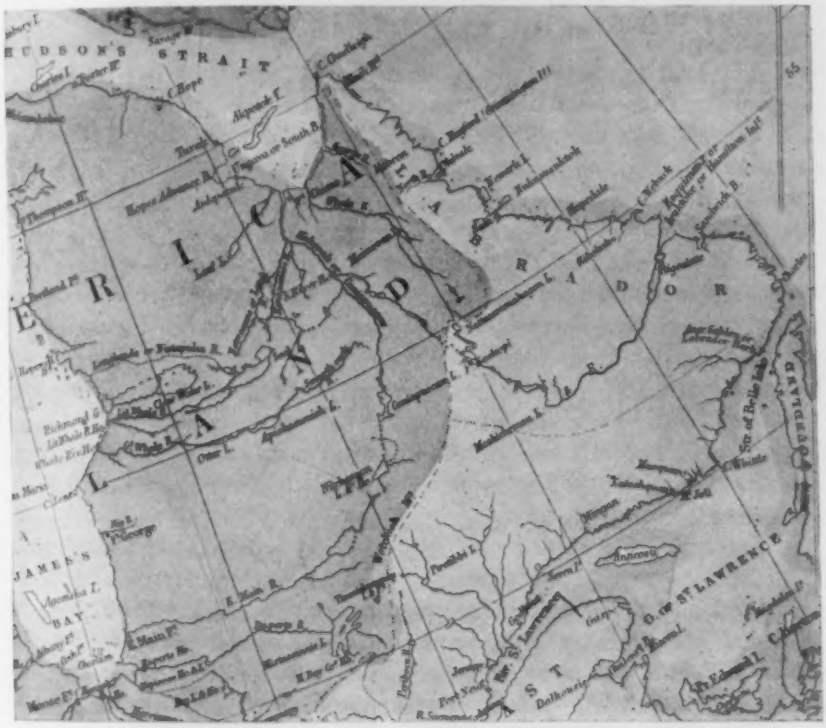

FIG. 2—Reproduction on a reduced scale of a portion of Arrowsmith's "Map of North America," 1857, showing the territories claimed by the Hudson's Bay Company.

and, when some thirty years back the modern method of making paper out of spruce wood began to take form, parties sought and secured timber-cutting licenses from her in different parts of Labrador. One concern obtained such a right on the Hamilton River in 1902, and when this took place the Quebec Government intervened, claiming that the south bank of the river belonged to them, and enforced their view by sending a steamer to the region with government officials on board, who seized the logs of the lumber company and forbade further activity. Newfoundland, having given the license, had no alternative but to back the lumbermen before the Quebec courts, where civil action was taken by the Quebec authorities. In the meantime, the two governments and the Imperial authorities opened negotiations for a settlement of the whole question by its submission to the Privy

Council. This was agreed to, and the work of preparing the case was put in hand. Delay followed from various causes. During the war there was a complete cessation of activity, and political convulsions in Canada and Newfoundland, from time to time, contributed their quota. Finally, the case was put to trial in October, 1926, and, as already said, the decision was given on March 1, 1927.

The Issue Before the Tribunal

The trial was before the Judicial Committee of the Imperial Privy Council. This committee, composed of the reigning Lord Chancellor, his predecessors in that office, and other eminent judges, both of the mother country and the oversea possessions, is the last court of appeal for all the British dominions except Great Britain and Northern Ireland. The Lord Chancellor, Viscount Cave, because of the importance of the case, took the presidency of the Tribunal. The other four members included Lord Haldane, who had participated in the adjudication of three cases between the Province of Quebec and the Dominion of Canada regarding fishing and other rights in that Province, and Lord Finlay, who had had experience in the dispute respecting the North Atlantic Fisheries between Great Britain (representing Canada and Newfoundland) and the United States arbitrated at the Hague in 1910, and also in the arbitration over the boundaries of British Guiana.

The hearing occupied nearly four weeks and formed a loadstone which attracted to the Council Chamber leading lawyers of both England and her colonies, for the Imperial Conference of 1926 was proceeding in London at the same time, and virtually all the delegates from the different oversea possessions that were gathered for the occasion availed themselves of the unique opportunity afforded by the trial of seeing the Judicial Committee in action dealing with a case of outstanding interest to the colonies in general.

So important was the precise nature of the pronouncement desired from the Tribunal that the legal authorities on the two sides spent five years in correspondence respecting it, ultimately agreeing that the question to be submitted to the Judicial Committee should be as follows:

What is the location and definition of the boundary as between Canada and Newfoundland in the Labrador peninsula under the Statutes, Orders in Council, and Proclamations?

To assist the Tribunal in deciding this question both sides accumulated such a mass of documentary evidence[2] in the form of printed

[2] The documents presented by the two sides numbered 1631 and were included in eight volumes comprising 4200 pages, besides which each side had an atlas of 50 to 60 maps. Two indexes, one alphabetical and one chronological, were also provided; and printed reports of the argument at the trial ran to three more volumes of 500 pages each. Lastly, the judgment itself, a masterly production, an exhaustive review of the whole subject, covered 23 printed pages and exceeded 10,000 words.

material and ancient and modern maps, as has never been approached in the history of the British Courts; and for that reason, the decision was awaited with the keenest interest, not lessened by the fact that one party to the case was the populous, wealthy, and influential Dominion of Canada, stretching from ocean to ocean and occupied by some ten million people, while on the other side was the little colony of Newfoundland, with a population of only about a quarter of a million, the antithesis of Canada in each of these respects.

Seaboard Strip or Watershed

The issue between the two countries, presented to the Tribunal for determination, was embodied in the question, What was meant by the phrase, "the coast of Labrador," or, as some of the documents had it, "all the coasts of Labrador," as used in the official instruments of the period; or, in other words, was the "coast" a mere strip of seaboard, such as would be required merely for the uses of the fishery, as Canada contended, or was it the watershed, as Newfoundland contended, accepting the word "coast" in its larger rather than its restricted meaning?

The meaning of the term "coast" was the subject of intensive investigation; sacred and profane literature was invoked in its interpretation. Thus the authorized version of the Bible of 1611 was quoted by Newfoundland in support of its contention that the word "coast" as used in connection with Labrador in the pertinent documents meant a "country" and not a mere strip of seaboard, as for instance, "Every place whereon the soles of your feet shall tread shall be yours; from the wilderness and Lebanon, from the river, the river Euphrates, even unto the uttermost sea shall your coast be" (Deuteronomy, 11:24). "Then Herod, when he saw that he was mocked of the wise men, was exceeding wroth, and sent forth, and slew all the children that were in Bethlehem, and in all the coasts thereof, from two years old and under" (St. Matthew, 2:16).

Numerous other instances from dictionaries, geographies, and law books of the use of the word in the same sense were included in the documents, and the writer of the editorial on the case in the London *Daily Telegraph* on the morning after the decision said: "It may be recalled—though the fact is hardly evidence, perhaps, for a legal tribunal—that the whole extent of Hades was 'the dreary coast of Pluto,' for the purposes of Pope's translation of Homer."

In the discussion over the term coast it was pointed out that vast areas of territory were known as "coasts"—the Gold Coast, the Coromandel Coast—a usage arising from the common method of occupation of a new country. It has been generally admitted that occupation of the coast carries with it a right to the whole territory drained by

the rivers emptying thereon, unless the hinterland already enjoys other effective occupation. That this was intended to apply in the case of Labrador is suggested by the fact that on the one side the Hudson's Bay Company's territory, by the original grant, comprised all the lands drained by the rivers that flow into Hudson Bay or Strait, and, on the other side, that the southern boundary of the Province of Quebec ran along the crest of the mountains which separated the rivers flowing into the St. Lawrence from those flowing into the Atlantic.

Moreover, by the Proclamation of 1763 the Province of Quebec is described as bounded on the north by a line drawn from the head of the St. John River to the westward, a description which leads to the inference that the land on the east or left bank of the St. John from its head to the sea had been already allotted to the Government of Newfoundland. By the Act of 1825 it was provided that so much of the said "coast" of Labrador as lies to the westward of a line to be drawn due north and south from the bay or harbor of Ance Sablon inclusive as far as the fifty-second degree of north latitude should be reannexed to and made part of the Province of Lower Canada. Such a line would penetrate the interior of the country for about forty miles, and the land to the westward would in some of its parts cover a distance of over one hundred miles from the sea; wherefore, it would seem that the language of this enactment, construed in its plain and natural meaning, points directly to the inference that the expression "coasts of Labrador," as used in 1763 and 1809, was understood by the British Parliament in 1825 to have comprised the interior of the country back to these limits.

Furthermore, it was held that Newfoundland's case did not depend on the use of the word "coast"; that alternatively the region granted to her, whatever it was, was repeatedly referred to as the "territory" of Labrador; and that this "territory," according to the phraseology of the official documents, was something more than a mere strip. Thus reference was made in these early documents to the "territories of Labrador" and to the planters or inhabitants resident there, authorizing successive governors to appoint judges and justices of the peace to hold courts of Quarter Sessions, and to erect on the "coast" courthouses. The Tribunal held it to be plain that a criminal jurisdiction limited to a narrow coastal strip would be very difficult to exercise. Further, the judgment pointed out that the same instructions required the governors to report, not only as to the protection of the fishery, but also as to the security of the country and the establishing and carrying on of commerce with the Indians inhabiting the "coast" of Labrador. These and the directions for protecting the timber from waste, for reporting as to the number of inhabitants and of the furs taken by them, and for describing the improvement of the land, which apply

to Labrador, are appropriate to a government extending into the interior.

The Canadian proposal to restrict Newfoundland to a one-mile strip running along the foreshore over the whole territory would present immense difficulties in application. Some parts of this proposed ribbon of land lie at the summit of high land not accessible from the sea and hence would be of no use to the fishermen. On the other hand, in places where, owing to the existence of sea beach or of an inlet, opportunities for landing are available, a limit of one mile would be found insufficient. For the purpose of obtaining wood for repairs a strip three to five miles deep would possibly be needed. Still again, there are places where a broad peninsula is joined to the mainland by a neck of not more than two miles in width, and in each of these instances the one-mile strip would meet in the neck of the peninsula and cut off by an interposed barrier of Newfoundland soil access to the Canadian enclave on the broader part of the promontory. Therefore, the Tribunal argued that the Crown could not have intended to annex to Newfoundland an area of that shape and character, to refer to it as a "territory," and to establish a form of government there, and that this view would be fantastic if the strip were carried round the shores of Hamilton Inlet and Lake Melville, 150 miles back from the ocean.[3] To the argument that the territory claimed by Newfoundland is over twice the size of Newfoundland itself, it was replied that the territory in question, when compared with the vast regions with which the British Government was dealing at the time, was relatively small in area and infinitesimal in value.

Occupation and Control

Evidence of jurisdiction on the part of Newfoundland in the years following 1763 showed that the annexation of the "coast" had always been understood and treated as including the whole area lying between the sea and the watershed. The Tribunal emphasized the view that, before the final Act dealing with this region was passed, sixty years had elapsed and that these exercises of jurisdiction must have been in the mind of Parliament in the meantime.

In 1765 the Unitas Fratrum, a society of Moravian missionaries, asked for four tracts of land on the coast of Labrador, containing together about 400,000 acres, with a view to the settlement there of missions to the Eskimos; and, with the approval of the British authorities, certain missionaries were sent out and received the support and protection of Governor Palliser. The first grant was made in 1769 and directed the Governor of Newfoundland to give the grantees all reasonable assistance and support in forming their establishment. In

[3] Compare the note "Lake Melville, True Lake or Inlet of the Sea?" in the Record section of this number of the *Review*.—Edit. Note.

1774 two other similar grants were sanctioned and committed to the Governor of Newfoundland to be carried out, and in 1821 a fourth grant of a like nature was made to the same society. These lands penetrated into the country far beyond the suggested limit of one

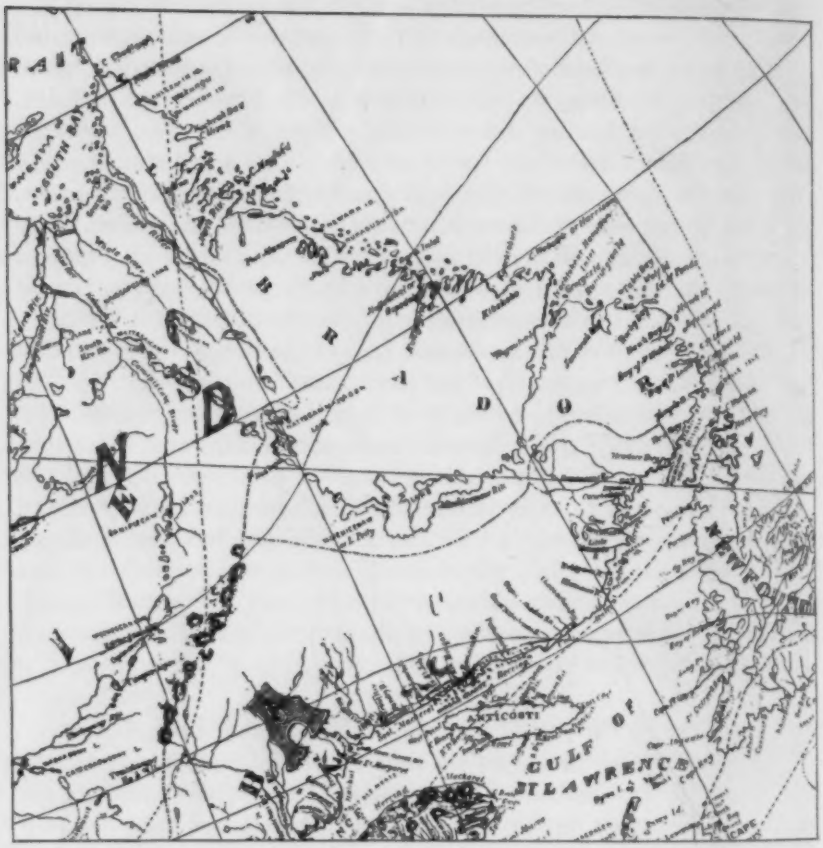

FIG. 3—Reproduction on a reduced scale of a portion of the map sent by the Canadian Government to the United States Government in 1874, showing the boundary between Labrador, "annexed to Newfoundland," and the Dominion of Canada. From a photostat copy kindly supplied by the Library of Congress, Division of Maps.

mile from high-water mark and in the case of the most northerly of them to a distance of about thirty miles from the shore. The Tribunal held that these grants, connected as they were with the government of Newfoundland, were consistent only with the existence of a Newfoundland jurisdiction extending beyond the littoral strip, observing that "it is hard to believe that when, in the year 1809, Parliament restored to Newfoundland the Coast of Labrador, it intended to divide the Moravian settlements then in existence, placing a small fraction of them (one mile in width), under the jurisdiction of the Colony, and leaving the remainder to Canada."

Another evidence of jurisdiction is that, in 1774, John Agnew and others, having petitioned for a grant of mines and minerals to be discovered on the "coast" or "country" of Labrador, between the St. Lawrence River and Hudson Strait, the King in Council approved of the grant to them of all such mines and minerals "upon such parts of the sea coasts of Labrador as lie within sixty miles of low-water mark of the open sea," a grant which, says the tribunal, "appears to treat the 'coast' as extending far inland from the shore."

The next point is as to the administration of justice on the coast. This throughout has been under the direction of the Governor of Newfoundland, in the early years by Naval Surrogates exercising their functions on board their vessels or from some place close to the seashore. By the Act of 1809 the Jurisdiction of the Supreme Court of Newfoundland was extended to Labrador; in 1811 the institution of surrogate courts for that purpose was authorized, and in 1824 the Governor of Newfoundland was empowered to institute a court of civil jurisdiction on the "coast" itself and appointed a judge therefor; and records were put in evidence showing that the judge so appointed exercised his functions at various places in the Labrador territory, some of which—the head of Hamilton Inlet, for instance—would have been far outside his jurisdiction if it had been limited as claimed by Canada. In 1834 the Legislature of Newfoundland, which had been established, abolished the court on the ground of expense; but the same Legislature in 1863 revived the court, which continued till 1874 when it was again discontinued for the same reason, each of these judges, in addition to performing his judicial duties, making a report from time to time on various questions relating to the territory, including roads, schools, churches, and the fur trade.

Similarly, customs duties have been levied on behalf of the government of Newfoundland on goods disembarked at Labrador from about the year 1826 to the present time, and the right of the government to collect such duties has from time to time been affirmed by the Secretary of State in London. In 1864 Donald Smith (afterwards Lord Strathcona), who was in charge of the Hudson's Bay Company's trading station at North West River, agreed, after some demur, to pay the duties on goods at that place; and such duties have since been regularly paid. Finally, the Tribunal makes the pertinent comment that "no evidence was given of any exercise of a Canadian jurisdiction in any part of the territory in dispute."

Evidence in a Communication to the United States

The United States contributed indirectly to the solution of the dispute by some diplomatic despatches going back to 1874, wherein it sought information as to the ownership of Labrador. To this

inquiry Lord Dufferin, as Governor-General of Canada, sent his reply through Sir Edward Thornton, the British Ambassador in Washington, the reply being really a copy of the report of a Committee of the Privy Council approved by the Governor-General in Council on November 1, 1874, which was in the following terms:

> In a despatch dated 20th June, 1874, from Sir Edward Thornton to Your Excellency, inclosing a communication from the Hon. Hamilton Fish, Secretary of State at Washington, desiring to be informed whether any part of Labrador is separated from the jurisdiction of either the Dominion of Canada or that of Newfoundland.
>
> The honorable the secretary of state, to whom this despatch, with inclosures, has been referred, reports that the boundary-line between the Dominion of Canada and Labrador is a line drawn due north and south from the bay or harbor of Ance au Blanc Sablon, near the straits of Belle Isle, as far as the fifty-second degree of north latitude; that Labrador extends eastward and northward from that point to Hudson's Straits.
>
> That the division-line in the interior separating Labrador from the Dominion of Canada has only been defined as far north as the fifty-second degree of north latitude, but it has been assumed that the boundary-line in the interior would have taken the direction laid down on the accompanying map, which follows the height of land.
>
> That Labrador, with the islands adjacent thereto, is annexed to Newfoundland, and under the government of that Island.
>
> Attached to the report of the secretary of state are extracts from the imperial statute bearing on the question, and a map showing the exact boundary on the coast and the assumed boundary in the interior.
>
> The committee recommend that a copy of this minute, with map and extracts from the imperial statutes above alluded to, be transmitted to Sir Edward Thornton for the information of the United States Government.[4]

It will be observed that this map (see Fig. 3), a copy of which was put before the Tribunal by Newfoundland, was sent to Washington as "showing the exact boundary on the coast and the assumed boundary in the interior"; and the Tribunal observes that it "assigns to that territory the exact boundaries claimed for it on behalf of Newfoundland." As regards the whole series of maps issued by departments of the Canadian Government from 1874 down to 1900, the Tribunal expresses itself in these terms:

> The maps here referred to, even when issued or accepted by departments of the Canadian Government, cannot be treated as admissions binding on that Government, for even if such an admission could be effectively made, the departments concerned are not shown to have had any authority to make it. But the fact that throughout a long series of years, and until the present dispute arose, all the maps issued in Canada either supported or were consistent with the claim now put forward by Newfoundland, is of some value as showing the construction put upon the Orders in Council and statutes by persons of authority and by the general public in the Dominion.[5]

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[4] Papers Relating to the Foreign Relation of the United States, Transmitted to Congress . . . December 6, 1875. Washington, 1875, Vol. 1, p. 644.

[5] In the Matter of the Boundary between the Dominion of Canada and the Colony of Newfoundland in the Labrador Peninsula . . . Report of the Lords of the Judicial Committee of the Privy Council, delivered the 1st March, 1927, London, 1927, p. 22.

FIG. 4—The Labrador boundary according to the Judgment given March 1, 1927. Scale of the map a little over 1: 1,000,000. No arrangements have as yet been made for the demarcation of the boundary. As Mr. A. R. Hinks points out in the *Geographical Journal* for July, 1927 (pp. 42–43), this will not be easy, since it calls for identification of the watershed in the complicated drainage of a recently glaciated plateau.

The decisions of the Judicial Committee take the form of a Report to the King in Council, by whose Order in Council it is then approved and becomes of binding effect. The Tribunal rendered its finding over the Labrador question thus:

> Upon the whole, their Lordships, having considered the facts and arguments put before them with the care which is necessary in a matter of such grave importance, have come to the conclusion that the claim of the Colony of Newfoundland is in substance made out. . . . For the above reasons their Lordships are of opinion that, according to the true construction of the Statutes, Orders in Council and Proclamations referred to in the Order of Reference, the boundary between Canada and Newfoundland in the Labrador Peninsula is a line drawn due north from the eastern boundary of the bay or harbour of Ance Sablon as far as the fifty-second degree of north latitude, and from thence westward along that parallel until it reaches the Romaine river, and then northward along the left or east bank of that river and its head waters to their source and from thence due north to the crest of the watershed or height of land there, and from thence westward and northward along the crest of the watershed of the rivers flowing into the Atlantic Ocean until it reaches Cape Chidley; and they will humbly advise His Majesty accordingly.[6]

The Tribunal made two inconsequential changes in Canada's favor at Blanc Sablon. Here usage had fixed a river running into the center of the harbor as the boundary, but the Tribunal held that, following the words of the 1825 Act, which attached to Quebec the strip westward of the bay or harbor of Ance Sablon inclusive, the boundary line should run north from the eastern point of the bay to the 52nd parallel, thus giving Canada a strip one and one-half miles along the strand and 40 miles deep, or 60 square miles in all, with Woody Island (area 1 square mile) lying off this harbor and also held by Newfoundland previously. In all other respects Newfoundland's claim was maintained.

Value of the Labrador Region

The natural resources of the Labrador area awarded to Newfoundland are considered to be very great. Of the total area of 100,000 square miles 60,000 are estimated to be forested, and of this more than half to be capable of producing timber of commercial value. Canadian lawyers engaged in the Boundary Case estimated the value of the forest wealth of the area to be $250,000,000. Mr. E. M. Kindle, of the Canadian Geological Survey, in an article in the *Geographical Review*[7] refers to:

> . . . . the heavily forested vast interior Labrador, traversed by countless streams and dotted with thousands of lakes. In this interior region salmon and trout fishing take the place of cod fishing. A summer climate replaces the ice-chilled coastal climate, and forests cover both mountains and valleys.

[6] *Ibid.*, pp. 22, 23.

[7] E. M. Kindle: Notes on the Forests of Southeastern Labrador, *Geogr. Rev.*, Vol. 12, 1922, pp. 57–71.

Labrador will probably play a very important rôle in supplying forest products for the world market of the future." . . . the Lake Melville waterways "are of peculiar importance in this connection because they afford about 200 miles of navigable waters which are usable by seagoing vessels . . . an important element in keeping transportation costs at a low figure.

The peltry wealth is also considerable. As to this Kindle goes on to say:

At present the forests supply only by-products in the shape of fur-bearing animals. In one sense the annual fur catch may be regarded as a forest by-product. The heavy forests produce what is said to be the finest grade of fur known in the north. . . . Minks, weasels, and martens are the more common fur-producing animals. Red, cross, silver, and white foxes are trapped—the last generally being found only near the coast. The otter, lynx, and beaver are also present. This region is near the southern limit of the range of the polar bear, which is sometimes taken on the sea-coast; but it, like the seal, belongs to the sea rather than to the forests.

Quite as valuable as the forest wealth, it is believed, is its wealth in water powers. These are numerous, and chief among them is the famous Grand Falls on the Hamilton River, some 235 miles from tide-water, respecting which Professor A. P. Low, who explored the region for the Canadian Government in 1894 says, in a chapter contributed by him to Grenfell's "Labrador":

The distance, between the lake expansion at the upper end of the portage route and the mouth of Bowdoin Canyon, is eight miles in a straight line running south-southeast. The river at the upper end of this line has an elevation of sixteen hundred and sixty feet above sea-level, a little below the general level of the surrounding country. Where it issues from the canyon into the main valley, it is nine hundred feet above the sea; there is thus a drop of seven hundred and sixty feet in a distance, by the river, of less than twelve miles. Considering the volume of the stream, estimated at fifty thousand cubic feet per second, this is a phenomenal descent. If the energy developed by the fall could be turned into work, it would produce the enormous amount of upwards of four million three hundred thousand horse-power. Neglecting the rapids above and below the falls and confining the calculation to the power of the falls itself, we find that it would develop energy equal to one million seven hundred thousand horse-power, an amount sufficient to operate a large proportion of all the manufactories and railways of Canada.[8]

On the river there are several other falls, notably the Muskrat Falls, less than thirty miles from tidewater and capable of developing in the present unregulated condition 500,000 horse power, with the possibility of doubling this production by proper regulation of the stream.

Numerous other rivers exist in the territory, all of which have extensive water-power possibilities that have not yet been measured or even considered.

What is true with regard to the timber possibilities of Labrador is equally true with respect of water-power possibilities. Nowadays the two are harnessed together, water power being the chief factor in

[8] W. T. Grenfell: Labrador: The Country and the People, new edit., New York, 1922, pp. 151–152.

the production of paper and being used for many other purposes besides, all of which tend to enhance the potential value of the hydro-electric energy in this region.

The mineral possibilities of the territory have not yet been seriously weighed. Professor Low is the authority for the statement[9] that west of the watershed beyond the Grand Falls there are enormous deposits of iron ore which are bound to be developed in the future. Some students of the problem think that in the smelting of these electric energy from the Grand Falls will probably be utilized, the resulting product being then shipped to tidewater by a railroad which will probably be built northward from Belle Isle Strait to a suitable point. Along the line of railway it is also suggested that a power transmission line will some time be constructed for the conveyance of electricity to tidewater whence it may be utilized in connection with industries established on the coast, or perhaps carried across to Newfoundland and put into service in connection with a variety of industries which the possession of this power will make it possible to inaugurate there.

Some idea of what the future of Labrador may be can be gained by a study of the case of Alaska, which occupies a somewhat similar position at the western end of North America that Labrador does at the eastern end. Alaska was purchased by the United States from Russia, in 1867, for $7,200,000; and when this was paid there was much outcry in America against the transaction because it was thought that the region would never be worth anything. In the past sixty years the production of gold, coal, and other minerals from Alaska, together with its fishery, forest, and other wealth has returned to the United States the amount of its investment a hundred and more times over. In the light of that example it is not unreasonable to suppose that something similar may occur with regard to Labrador.

[9] A. P. Low: Report on Explorations in the Labrador Peninsula along the East Main, Koksoak, Hamilton, Manicuagan, and Portions of Other Rivers in 1892–93–94–95, *Ann. Rept. Geol. Survey of Canada for 1895*, Part L, p. 284.

GEOGRAPHY AT THE FIRST INTERNATIONAL CONGRESS OF SOIL SCIENCE

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THE First International Congress of Soil Science was held in Washington, D. C., from June 13 to June 22, 1927.[1] Its work included the reading and discussion of papers, the exhibition of scientific material, the formulation of recommendations regarding future work, and the excursions. Papers were presented in general sessions and in meetings of the several International Commissions by which the technical work of the International Society is performed.

Papers of General Interest

Among papers read at the general sessions one by Dr. Albrecht Penck, discussing the probable ultimate capacity of the earth for supporting population, has a special geographical interest. Dr. Penck, who has given the subject a great deal of attention, has already published his views thereon.[2] The fundamental basis of his estimate of the possible capacity of the earth is climatic. He gives the tropics, Brazil for instance, an extremely high rating. He assigns only 14 per cent of the total ultimate world population to the North American continent and about 26 per cent to South America. Penck realizes that the soil factor has been almost wholly neglected in his estimate and for that reason places special emphasis on the importance of preparing and publishing a soil map of the world. This was suggested to him in part by the action of the General Committee of the International Society of Soil Science, in agreeing unanimously to direct its attention at once to the preparation of such a map. The governments of all countries will be urged to inaugurate without delay the work of preparing soil maps of their respective areas. Funds will be sought from private sources also, and effort will be made to have exploring and other scientific expeditions, organized in the future, include well trained soil specialists in their scientific staff.

Another important paper was Dr. O. E. Baker's excellent interpretation of present-day trends in American agriculture based on the data of the 1925 agricultural census of the United States. This will soon be published as a bulletin of the United States Department of Agriculture.

The Presidential address by Dr. J. G. Lipman, "Soils and Man," also had con-

[1] Four meetings of soil specialists, international in their scope, had taken place previously. The first was held at Budapest, Hungary, in 1908 and was designated as an Agrogeological Conference. A second was held in Stockholm in 1910, while the third was to take place in Russia in 1913, but conditions arose previous to the time of meeting which made it necessary to postpone it. No meeting was held during the war. In the spring of 1922 a number of specialists who had taken part in the Budapest and Stockholm meetings organized a Third Conference which met in Prague, Czechoslovakia, in April of that year. At the invitation of the Italian Government and the International Institute of Agriculture at Rome it was agreed to hold the Fourth Conference in Rome in May, 1924. At this meeting an International Society of Soil Science was organized as a permanent body under whose auspices future meetings of soil specialists should take place. The first meeting to take place under the new organization was the First International Congress of Soil Science at Washington in June, 1927.

[2] Albrecht Penck: Das Hauptproblem der physischen Anthropogeographie, *Sitzungsber. Preuss. Akad. der Wiss., Phys.-math. Klasse*, Vol. 22, 1924, pp. 242–257; also published in *Zeitschr. für Geopolitik*, Vol. 2, 1925, pp. 330–348.

siderable geographic value. It consisted of a brief summary of the salient facts of the agricultural history of Western Europe and America interpreted in terms of soil productivity and the increasing knowledge of and skill in handling the soil.

One afternoon and an evening session of the Congress as a whole were devoted to the presentation, by the Russian delegation, of the results of Russian work in soil investigation. These results were summarized in a series of brochures in English, prepared in attractive form and presented to the members of the Congress. This constitutes the first complete statement in English of Russian accomplishments in this field, except the book published in German by Glinka more than ten years ago and now for the first time available in English.[3]

The Soil Commissions

The Commissions, six in number, deal respectively with (1) Physics of Soils; (2) Chemistry of Soils; (3) Biology and Biochemistry of Soils; (4) Fertility of Soils; (5) Classification, Nomenclature, and Mapping of Soils; (6) Management and Technology of Soils.

The work in most of them was predominantly technical rather than geographic. This may seem at first glance necessarily so, but more careful consideration suggests that each may in time trend strongly in a geographic direction. In fact, from one point of view one would seem justified in designating the part of their work that does not have a definite geographical relationship as preliminary and immature. The study of the physics of soils, for instance, cannot be carried out without the study of some particular soil or soils each of which not only has a definite distribution over the earth's surface but has a definite and intimate relationship to those forces prevailing on the earth's surface which determine the character and distribution of organic life including that of man.

This stage in the work of most of the Commissions has not yet been reached, at least in the United States and western Europe. It has been reached in Russia, and the accumulation of results has begun. It is expected that the western world will learn a great deal about them when the next International Congress of Soil Science meets in Leningrad in 1930.

Classification, Nomenclature, and Mapping

The Fifth Commission, on Classification, Nomenclature, and Mapping of Soils, dealt with soils from a geographic point of view to a much greater extent than did any of the others. This is especially true in its treatment of soil cartography and also in classification, since in the latter term is included not merely the assignment of soils to certain "pigeonholes" in a scheme of arrangement but also the creation of soil units or groups through the determination, evaluation, and comparison of their characteristics and the working out of soil genesis in terms of environmental relationships.

At the Rome Conference in 1924 it had been agreed that the pedologists of the Conference would concern themselves up to the time of the Washington meeting in 1927 with the accumulation of actual soil knowledge expressed in terms of the soil profile features in order that an attempt might be made to classify the soils of the world on the basis of soil features rather than on that of climate, geology, crops, natural vegetation, or any other basis not residing in the soil itself.

The response was very gratifying. Data, in large quantity, were presented, both in the form of descriptive material and as colored charts, the latter from Norway, Russia, Rumania, Hungary, Latvia, and the United States being especially

[3] D. K. Glinka: The Great Soil Groups of the World and Their Production, Edwards Brothers, Ann Arbor, Mich., 1927.

abundant and significant. Nearly all of this material was presented to the Bureau of Soils and will be used as the nucleus of a great soils exhibit as soon as a permanent place can be found in which to install it. It is now in storage in Washington. The material presented by Russia alone is greater in quantity and more significant in quality than that of all the other countries combined.

A paper by Professor Polynov was especially important from the geographical point of view. He showed that the soil to a greater extent than any of the other features or bodies occupying the earth's surface, even including animals, expresses in its features the combined effect of all the forces of the geographic environment.

Two sub-commissions to the Fifth Commission were concerned with the preparation of soil maps of Europe and the Americas respectively. The European subcommission headed by Dr. Hermann Stremme of Danzig prepared and presented to the Congress the first soil map of Europe in which the great soil groups of the Continent, differentiated on the basis of broad soil characteristics, were shown. The map, accompanied by a brief descriptive text, has been published by the Prussian Geological Survey, through the efforts of Dr. W. Wolff, the secretary of the subcommission. In addition, a revised soil map of European Russia, brought up to date by Professor Prassolov, constituted a part of the Russian exhibit. It will be published shortly. A recently prepared soil map of Poland, differentiated in considerable detail, was presented by Dr. Michlaschewski. It has been published by the Government of Poland. Professor Treitz presented maps of Hungary; Professor Saidel, of Rumania; and maps of Esthonia and Latvia were sent for exhibition.

No attempt was made by the sub-commission on the soil map of the Americas to present a soil map of either of the continents. The data available for Mexico, Central America, and South America are as yet wholly inadequate for an attempt at even a generalized soil map. A small and very much generalized but highly significant map of Chile was presented by Dr. Matthei and a soils map of Cuba by H. H. Bennett of the Bureau of Soils, but for none of the other Hispanic American countries was a soil map attempted.

The recently prepared and yet unpublished soil map of the United States on the scale of 40 miles to the inch was presented as the most important of the results accomplished in the mapping of the Americas. It will shortly appear as the Soils Section of the Atlas of American Agriculture. Generalized soil maps of two important Prairie Provinces, Alberta and Saskatchewan, Canada, by Professors Wyatt and Joel, were presented in manuscript.

The Excursions

The excursions, local and transcontinental, formed a very important part of the congress. They will undoubtedly result in work of greater geographic value than any of the other general divisions of the congress. They were concerned entirely with the distribution over the American continent of soil characteristics and the relationship of these to the other factors of man's geographic environment. They assume especial significance because of the fact that on the North American continent there seems to be a wider range of varying geographic forces producing a correspondingly wide range of soil characteristics than can be found on any other.

A number of the most important soil groups of the North American continent are not represented at all in Europe or, if so, occur in such small area and in such imperfect development that they have received little attention. Furthermore, several of the groups developed in eastern Europe exhibit a much wider range of variations in this country. This is especially true of the groups of Steppe, or, as we call them in this country, Great Plains, soils. In Europe these soils occur in a series of east-west belts succeeding each other from north to south. They are the product of climatic forces, the two effective factors of which, rainfall and temperature, both

change from north to south, the rainfall decreasing and the temperature increasing. In the North American continent, however, one of these factors changes from east to west, the other from north to south. Instead therefore of a series of parallel belts differing in accordance with the combined effect of these two factors we have a checkerboard arrangement of areas and therefore a much greater number of condition variations. Our soil belts become soil areas approximately rectangular. There are a great number of soil units, and we have also presented to us an opportunity to determine the effect on the soil of increase or decrease of moisture without change of temperature or, vice versa, of increase or decrease of temperature without change of moisture.

Not only has the crosswise distribution of the two great climatic factors in soil development produced in this country a great number of sub-varieties of the well known soil belts, as developed in Europe, but other factors in soil evolution, not fully functioning in Europe, have produced soil groups not known at all, or in imperfect development only, in Europe. Four such groups of soils are (1) brown forest soils; (2) red forest soils; (3) yellow forest soils, and (4) prairie soils.

Four Soil Groups of Particular Interest

The brown forest soils are similar to the brown soils named by Ramann but not described in detail by him. It is apparent, however, that because of the moist climate in central western Europe the occurrence of soils of this general character with fully developed, or what we in the United States call mature, characteristics is there very limited. The dryness of the forested regions of the United States where these soils are developed as compared with that of Europe was a constant cause of surprise to our European visitors. These soils were examined in typical localities in two full-day excursions in Maryland and Virginia during Congress week and in Missouri and Indiana during the transcontinental excursion.

The two great groups of red soils of the southern states were both visited. Those developed from limestones, seen in the Knoxville region, being essentially identical with those of southern Europe, presented no new problems, though notable for their wide range in variations, the definite expression of relationship one to another, and to their environment. The red soils of the Piedmont region, the prodigality with which they display their color richness, and their wide extent and relationships received the maximum of attention during the first few days of the transcontinental excursion. Such soils are almost unknown in Europe, those on certain small areas in the Caucasus region approaching them in character. Interest in them centered around the question of the period during which their striking characteristics were developed. Glinka has expressed the opinion, seemingly not entirely concurred in by his colleagues, that they are not the product of the existing climatic environment but are ancient (fossil) soils developed under conditions different from those of the present day. This raised the highly important question of recent or relatively recent climatic change. The large area and the clearly expressed characteristics of such soils in the United States may be expected to supply some important data toward the solution of the question of climatic change. The same question is involved in the discussions aroused over the highly important group of prairie soils to which reference will be made below.

One of the important groups of soils in the United States, wholly without representation in Europe, unfortunately could not be visited, though their characteristics were described and an interpretation attempted in the Guide to the Excursion. A region comprising the southeastern part of Georgia, a small area in South Carolina, the southern part of Alabama, and all of Florida is covered with a group of soils which seemingly represent the northern extension of influences prevailing widely in the tropics and responsible for their highly characteristic soils. These soils are in

a sense fossil but do not necessarily present evidence of a recent change of climate. The climate then as now seems to be identical in kind if not in degree of expression to that prevailing in the tropics. The fossil character is to be ascribed rather to topographic change and represents normal development rather than revolution. The same questions raised by these soils are raised by those of Cuba, recently studied by Bennett. They will constitute the subject of some new geographic literature in the near future.

The soils whose features provoked the liveliest discussions of all, and over the interpretation of which the widest differences of opinion prevailed, are those of the American prairies, or the humid grassland soils. The fact that they are practically unique among the soils of the world, as well as their very great economic importance, added interest to the discussions. The point on which the widest difference of opinion prevailed was their assignment by the Russians to the degraded *chernozems*.

In Russia the forests are spreading southward over country that until recently was grassland and was covered by soils with well defined *chernozem* characteristics, such as dark color, highly developed granular structure, and zone of carbonate accumulation—features defined by them as those developed only under the influence of low rainfall (about 20 inches in mid-Russia) and a grass vegetation.

Where forests have invaded such a region the soils gradually lose their dark color and their granular structure. However, in no place in the literature is a soil identified as degraded *chernozem* in which the zone of carbonate accumulation is not still intact, although our unfamiliarity with the Russian language in this country may have led us into an error regarding this point. In none also is a soil now lying in a region of 30 inches or more of rainfall identified as degraded *chernozem*.

When the true normally developed prairie soils were first seen near Kansas City they were immediately identified by the Russians as degraded *chernozem* regardless of the fact that they lie in a region where the rainfall is now as high as 35 inches, and in which there seems not only to be no trace whatever of a zone of carbonate accumulation, but where the parent rock carbonate has been removed to a depth of many feet. Such identification demands that the soils were originally developed under a rainfall of not more than about 25 inches, probably less, that after development they were invaded by forests, due to change of climate from dry to wet, were degraded, and still later were subjected to conditions—climatic or otherwise—which caused the disappearance of the forest cover.

The Americans among the excursionists found themselves wholly unable to agree with this interpretation in view of the complete absence up to date of correlative evidence of the necessary changes in climate. The Europeans themselves, after having considered all the factors so far as they are now known, frankly admitted that the case is a complicated one and requires much research.

Another region regarding which considerable difference of opinion manifested itself is that in the vicinity of Edmonton, Alberta. According to the American interpretation the predominant soil in this region consists merely of one of the several if not of the many varieties of the soils of the *Chernozem* belt, a variety whose divergence from true *chernozem* is due to short summers, relatively low temperatures, and early summer rainfall. By many of the Europeans, however, it was identified as a member of the *Wiesenboden* group, a group of soils imperfect in their development on account of an excess of moisture. That the moisture is superficial, however, and does not affect the whole soil profile is shown by the presence in them of a well developed zone of carbonate accumulation.

GEOGRAPHICAL RECORD

NORTH AMERICA

Lake Melville: True Lake or Inlet of the Sea? The evidence presented by the Colony of Newfoundland and the Dominion of Canada in their recently settled boundary dispute constitutes almost a library on Labrador in itself, filling eight substantial volumes. The geographical documents include extracts from most of the published works on the country, as, for instance, those of Dr. A. P. Low and Dr. (now Sir) Wilfred Grenfell; and special mention may be made of an excellently illustrated section by R. A. Daly on the "Topography of the Northeast Coast of Labrador." Probably the most interesting point geographically is the argument over Lake Melville (see the map, Fig. 4, p. 657). In the event of the Dominion establishing its main contention Newfoundland had intended to claim that the littoral strip should be carried round the head of the Lake—150 miles from the outer coast. Fortunately for the Colony, this issue did not arise.

The best description of Lake Melville available is E. M. Kindle's "Geography and Geology of Lake Melville District, Labrador Peninsula" (*Canada Geol. Survey Memoir 141*, 1924), extracts from which are among the chief Canadian evidence. The lake is fiord-like, with a maximum depth of 160 fathoms; steep scarps rise to 2000 feet on the south; the northern scarp is less steep and more irregular. To the west the lake is bordered by a terraced plain. In sum, says Kindle, the main physiographic features "are in their essentials the products of subaerial and river erosion modified by glaciation and directed in some degree by important structural features." The shallow outlet of the Narrows, 9 to 30 fathoms deep, represents a postglacial channel, the preglacial Hamilton reaching the sea by the Backway channel. Hamilton Inlet is relatively shallow and is classed by Kindle as a ria.

Professor J. W. Gregory, on the other side and supported by Professor Schuchert, emphasizes the "essential unity" of the three bodies of water, Lake Melville, Narrows, and Hamilton Inlet; he discusses the general physiography of the coast and explains Lake Melville as a fiord, due to faulting. Professor Douglas Johnson disagrees with this interpretation of the lake and, furthermore, maintains that the fiord question is not relevant here. He suggests that light may be shed on the problem by imagining the effect of a considerable drop in sea level—say 1500 feet. Lake Melville would still retain its essential conformation as a characteristic expansion of the river, whereas Hamilton Inlet would disappear, being replaced by a river channel. Parenthetically, reference may be made here to the characteristically clear discussion of coast terminology included in Professor Johnson's evidence.

Navigability by ocean-going vessels, a considerable degree of salinity, and the tides of Lake Melville are brought forward by Newfoundland as evidence in favor of its maritime character. On the other hand W. J. Stewart, chief hydrographer of Canada, points to the ebb tide of greater flow and longer duration and the retardation of the tidal wave as characteristic of river tides, with which view G. W. Littlehales of the U. S. Hydrographic Office does not agree. W. Bell Dawson, superintendent of the Tidal and Current Survey of Canada considers Ticoralak Point, a few miles below the Narrows, as the "crucial" point representing the head of the estuary, for here the tide is at its maximum. Leveling operations carried out by Canada were not conclusive.

As regards salinity of the waters, Kindle gives as his opinion that a pronounced change marking the westward limit of truly maritime conditions occurs at Indian Harbour in Hamilton Inlet. C. Tate Regan, formerly of the British Museum, con-

siders Kindle's investigation incomplete and states that his selected maritime species are found elsewhere in waters of as low or lower salinity. M. L. Fernald also questions certain identifications and statements as to habitat, citing maritime plants found at the head of Lake Melville which elsewhere are confined to sea margins. Johan Hjört, consulted on the practical issue of the cod fishery, does not believe that the waters of Lake Melville are suitable for the sea cod; he points out that the Baltic cod is not a pelagic species. According to Grenfell it is safe to say that few cod enter Lake Melville. Salinity observations on the lake were made by the Canadians, but the depth observations are incomplete.

It is impossible to indicate here the great range and interest of the arguments; the above instances will serve to illustrate the complexity of the problem.

Newly Discovered Falls in the Hamilton Basin of Labrador. The glaciated plateau of Labrador and its myriad lakes "that occupy at a moderate estimate at least one-quarter of the total area" (Low) present a drainage tangle still awaiting solution. A correction and addition to Low's pioneer work in the Hamilton River drainage basin has lately been given by Mr. Varick Frissell (Explorations in the Grand Falls Region of Labrador, *Geogr. Journ.*, Vol. 69, 1927, pp. 332–340). In July, 1925, Mr. Frissell, accompanied by Mr. James Hellier, undertook an expedition to the Grand Falls region, aptly described as the "key to the development of the entire Peninsula" (compare Sir Patrick McGrath's paper in this number of the *Review;* and see the map, Fig. 4, p. 657).

Some excellent pictures of the great falls were secured, and the party then proceeded southwest in search of the "unknown channel" reported by Low as entering the main stream some few miles below Bowdoin Canyon. They struck the stream about twelve miles above its mouth and proceeded up it on the left or north bank. A continuous series of rapids brought them to the rumored falls. The river was split in two by a high island. The northern branch again divided, the two arms uniting halfway down to fall to the bottom 120 feet below. A close view of the southern falls was obscured by mist. These latter seem to be the ones described in the July, 1925, number of the *Geographical Journal* (p. 79) as seen by Mr. J. G. Thomas and named by him Grenfell Falls. Mr. Frissell proposes the name Yale Falls for those on the northern branch and Grenfell for the name of the river.

Exhaustion of provisions and threatening forest fires prevented further exploration above the falls, but as far as the eye could see the river flowed tranquilly between low shores. Considering the volume of water carried, Mr. Frissell believes that it is the Grenfell River that carries off the waters of Lake Ossokmanuan. Certainly it is not the "Valley River" of Low. This was shown to be a fossil valley, an old main valley of the Hamilton before glacial diversion. The upper part of this old valley has been obliterated, its place being taken by two small brooks which were crossed near their source on the return journey to the Hamilton.

Natural Divisions of the Region of Chicago. The Chicago Regional Planning Association has under its survey an area of some fifty miles radius from the city of Chicago. This "Region of Chicago," as it is termed, includes 250 towns and villages in the states of Illinois, Indiana, and Wisconsin. The first requisite of a regional survey, the base map, has been made under the direction of Professor J. Paul Goode. It shows counties, townships, sections, the checkerboard of roads that so largely define the sections, railways, rivers, canals. To accompany the map Mr. F. M. Fryxell has prepared a description of the natural features of the region (The Physiography of the Region of Chicago, University of Chicago Press, Chicago, 1927). The volume includes the base map on the scale of 4 inches to the mile, maps in color, showing glaciology, relief, drainage, and soils on a scale not stated but slightly less than half that of the base map; and numerous text maps, diagrams, and excellent photographs.

The Region of Chicago is almost at the center of the physiographic province called by Professor Fenneman the Central Lowland. Within the region itself alternating ridges, plains, and valleys roughly paralleling Lake Michigan lead to a differentiation into six natural divisions. The Lake Plain is a great industrial area. Its remarkable smoothness offers many advantages to urban growth offset in part by the drainage and sanitation problems presented. From the Plain the Chicago Outlet leads to the Mississippi Valley, crossing the Continental Divide at an elevation of only 15 feet above Lake Michigan. This important pass is now occupied by parts of the Des Plaines and Illinois Rivers and is traversed by the Illinois and Michigan and Chicago Drainage Canals and by highways and two railways.

FIG. 1—Natural divisions of the Chicago Region from Figure 2 of Mr. Fryxell's work.

Three morainic belts, the Lake Border, the Valparaiso, and the Outer Uplands, separated to the south, coalescing in the north, comprise good farm and dairy land. Those parts near Chicago are being increasingly developed for residential and recreational purposes. In the Lake Border Upland residential towns are continuous to the Wisconsin line, commuters to Chicago being well served by steam and electric railways. Still primarily an agricultural region, the Valparaiso Upland has a predominance of small country towns, the larger ones on the main streams or on the margin of the Lake Plain. The northern part of this Upland exhibits a more rugged relief, up to 450 feet, a picturesque "knob and kettle" topography. The central portion and inner edge of the Upland are connected with Chicago by a close net of railways and are developing a suburban character. The Outer Upland is an agricultural area. Between the Valparaiso and the Outer Upland lie the Manteno Plain and the Morris-Kankakee Basin. The Basin is mostly sandy and formerly was largely covered with marsh. Where drained it constitutes agricultural land. Sections, however, remain in a primitive state—a paradise of wild life—and their preservation is urged. Conservation of the interesting and beautiful dune country at the head of Lake Michigan, described in a chapter on the lake and its shore, is also urged. Indiana is planning a Dunes Park that will embrace 2000 acres.

Mr. Fryxell concludes his study with a brief account of the geology and geological resources of the region. Its economic advantages derived from soils, topography, and situation have been described by Professor Goode in a preliminary regional analysis "The Geographic Background of Chicago" (Chicago University Press, Chicago, 1926).

The Southern California Rift Club. The Southern California Rift Club was informally organized in the spring of 1926, with the object of bringing together the various scattered observers of the many rifts and displacements of that much fractured region and with the hope of thus defining better than has yet been done the location

of certain rifts, of determining the nature and the amount of the movement that has already taken place upon them, and of measuring any movement that may take place in the future. Several meetings of the club have been held, including an open meeting on Sunday, May 29, 1927, where more than a hundred members and friends gathered at Mountain View in the Narrows of Cajon Pass—that remarkable northwest-southeast depression by which the San Gabriel Range on the west is obliquely separated from the San Bernardino Range in the east. The Pass is familiar to many transcontinental travelers, inasmuch as the main line of the Santa Fe Railway and the Salt Lake-Los Angeles line of the Union Pacific make joint use of the tracks through it in the descent from the uplands of the Mohave Desert on the north of the mountains to the orange-grove lowlands on the south; but it is probable that few of those travelers realize the altogether exceptional character of that part of their route.

The pass appears to be largely due to the erosional excavation of great slabs, several miles in length, of relatively weak sandstones which have there been down-faulted between the much more resistant crystalline rocks of the mountain ranges; and as such it is certainly one of the most remarkable structural and physiographic features of the great Southwest. It is followed, but in a still more oblique, west-southwest to east-southeast course, by the famous San Andreas rift belt, on which the earthquake of 1906 was caused by a 15- or 20-foot, horizontal shift of the earth crust northwestward on the southwest side of the rift with respect to the northeast side in the San Francisco region. Whether the downfaulting of the weak sandstone slabs is due to early displacements on the San Andreas rift belt is not yet determined; but there seems to be a rather close association of the early and later movements in a single belt of compound, communicated fractures.

The president of the Rift Club, Dr. Levi F. Noble, opened the meeting and introduced Prof. J. B. Buwalda of the California Institute of Technology at Pasadena, who gave a general account of the San Andreas rift belt in the region of the Pass, emphasizing the numerous sub-parallel faults which it includes and describing the various geologic and topographic features by which it may be traced. He also explained that, in consequence of the complex displacements along the rift belt, which has a width of a mile or more, many great slices and slabs of rock, more or less crushed by the friction and pressure to which they have been subjected, are now found in discordant relation to one another and to the country rock on either side of the belt. The great length of the rift belt was also noted: it has been traced from the Pacific coast, north of San Francisco, through middle and southern California, and probably into Mexico: it should therefore be ranked among the major lineaments of the earth's crust.

Professor W. M. Davis of Harvard University next spoke, with especial regard to the contrast between rifts of the San Andreas type, on which movements with a large horizontal component seem to predominate, and rifts of the Wasatch type, on which movements with a large vertical component prevail. In examples of the first type the path or trace of the rift is nearly rectilinear, and there is no strong or persistent difference of elevation on its two sides. In examples of the second type the trace of the rift departs from a straight line in many concave bights from one to five or ten miles in curved length, between somewhat pronounced cusps which point from the side of elevation to the side of depression; and the side of elevation is occupied by a more or less dissected mountain range, while the side of depression is occupied by an aggraded plain of mountain-supplied detritus. Professor Davis also called attention to the importance of establishing monuments on the two sides of various rifts at selected points in order that future movements shall be detected.

Later Dr. Noble led the party up the near-by mountain slope on the northeastern side of the Pass over the Narrows, whence the direct course of the oblique rift belt was pointed out for a number of miles along the flanks of the mountains, to the west-northwest on the northern side of the San Gabriel Range and the east-southeast on

the southern side of the San Bernardino Range. Attention was also given in some detail to the occurrence of several great rock slabs of diverse composition and of large displacement in the rift belt, which Dr. Noble has recently been investigating for the U. S. Geological Survey. Many small movements on the rifts of recent date seem to have been the successors of greater, long continued earlier movements.

It was thus made clear that, if the excavation of the Cajon Pass is due to the erosion of the slabs of relatively weak sandstones which occur there, the downfaulting of those slabs must be of much earlier date than the recent movements on the rift belt, some of which are as yet little modified by erosion; but, even so, the earlier movements cannot be geologically ancient, because the downfaulted sandstone slabs are of relatively modern (mid-Tertiary) formation.

W. M. DAVIS

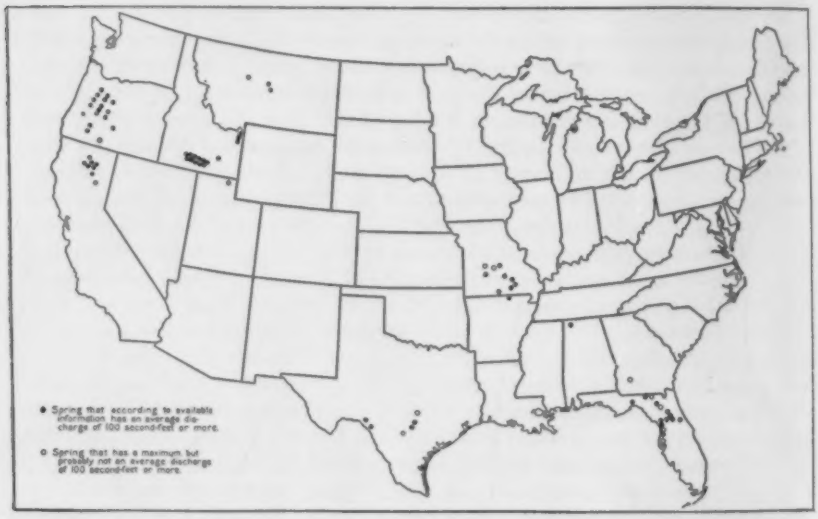
• Spring that according to available information has an average discharge of 100 second-feet or more.
o Spring that has a maximum but probably not an average discharge of 100 second-feet or more.

FIG. 1—Map of the United States showing the distribution of large springs. Reproduced on a reduced scale (about 1: 45,000,000) from Figure 1 of *Water-Supply Paper 557*.

Large Springs in the United States. Each region in the United States has its own favorite "Big Spring," but the information as to what constitutes a large spring and where they are to be found has hitherto been scattered. This gap has been conveniently filled by O. E. Meinzer's "Large Springs in the United States" (*U. S. Geol. Survey Water-Supply Paper 557*, 1927).

The basis of classification of the size of a spring is according to its discharge and is measured in second-feet (1 second-foot equals 1 cubic foot of water discharged a second, or 448 gallons a minute). Springs are considered to be of first magnitude when their discharge is 100 second-feet or more. According to available data there are 65 such springs in the United States.

In general the water discharged by these springs is meteoric water that has not reached depths of more than a few hundred feet below the surface. The result is that with few exceptions the temperatures of the large springs are not much above the mean air temperatures of the region in which they occur.

The large springs of the United States are scattered throughout the country from Florida to California, but those of first magnitude occur in relatively few regions (as shown on the accompanying map). The largest springs are usually found in limestone regions containing well worn solution channels, the work of ground water, or in areas

of jointed and broken volcanic rock. Only in rare instances are they found in gravel where water is more easily dispersed and not concentrated in one area.

A group of very large springs is found in northern and central Florida and adjoining parts of Georgia and Alabama, occurring in soft Tertiary limestone. This region is usually accredited with having the largest limestone springs in the United States, but at the present time measurements are too incomplete to substantiate this statement. Silver Springs, the largest of these, emptying into a basin about an acre in size and fully 35 feet deep, gives rise to a navigable stream. Measurements of the discharge range from 342 to 822 second-feet.

In the Ozark region of Missouri and Arkansas, chiefly in dolomitic rocks, seven springs with discharges ranging from 100 to several hundred second-feet have been recorded.

Two varieties are found in Texas, artesian springs occurring at the edge of the Coastal Plain in the fault zone and gravity springs in the Edwards Plateau where stream valleys have cut down to the water table.

In the drainage basin of the Snake River, Idaho, are a number of large and spectacular springs. Eleven of the first magnitude occur in a stretch of 40 miles along the Snake River below the Shoshone Falls. Of these, one (Malade) yields more than 1000 second-feet; three, from 500 to 1000 second-feet; and seven, from 100 to 500 second-feet. Most of the springs issue at such a height above the river that the potential power resources are very great. Power plants have already been installed at Malade, Thousand, and Sand Springs. It is interesting to note in connection with these figures that in 1925 New York City's daily consumption of water was about 800,000,000 gallons a day, or approximately 1238 second-feet, an amount that could almost be supplied by one of these springs alone.

The great area of basaltic rock containing the Idaho springs extends into northern Nevada, northeastern California, over most of Oregon, and over a large part of Washington. Springs rivaling those of Idaho are found here particularly in California and Oregon (Klamath River basin, west slope of Cascade Mountains in Oregon, and in the interior basin of Oregon).

Montana's springs rank among the very largest in the United States. The largest of these is Giant Springs, discovered in 1804 by Meriwether Lewis. It issues from a sandstone formation and discharges about 600 second-feet.

In spite of the magnitude of these springs the United States can lay no claim to the largest springs in the world. Measurements of the famous Fontaine de Vaucluse, which issues from a limestone formation, have given a maximum discharge of 5300 second-feet. This greatly exceeds any measurements in the United States. The average discharge is 800 second-feet; and this, too, is greater than that of any known limestone spring in the United States.

EUROPE

Three Recent Books on the Alps and Mountaineering. Most books and periodicals written by or for mountaineers are of interest to them alone—and more especially to those who have local knowledge of the various mountains concerned. Occasionally, however, there appear mountaineering publications of broader significance. These may be of two types: (1) studies of the history or philosophy of mountaineering in the large as distinguished from the records of particular climbs or the discussion of technical problems, and (2) interpretations for the climber or mountain lover of the geography of highland districts.

Alfred Steinitzer's "Die Alpinismus in Bildern," (Munich, 1924), a pictorial history of the Alps and "Alpinism" from the Middle Ages to the present time, is of the first type. Reproductions of the early woodcuts and prints of Alpine scenes and adventures—including a striking sketch by Leonardo de Vinci of a thunderstorm in

the mountains—are followed by a remarkable collection of photographs of mountain landscapes and climbers in action. Numerous facsimiles of drawings, paintings, posters, and bookplates are given; nor is the humorous caricature or grotesque cartoon neglected. These, together with views of military operations (particularly in the Italian Alps during the World War), airplane photographs, illustrations of mountaineering on skis, of Alpine roads, camps, refuges, cabins, funicular railways, etc., provide a graphic record not only of the growth of mountain climbing as a sport but of the improvement in the artistic technique of representing mountains.

Two recent books of the second type deserve mention. The first, "Entstehen und Vergehen der Alpen: Eine allgemeinverständliche Einführung besonders für Bergsteiger und Freunde der Alpen," by Dr. Wilfried von Seidlitz (Stuttgart, 1926), is an interpretation of the geology of the Alps written in simple language for all visitors to the mountains, but especially for the climber. Thus, a special section is devoted to varying kinds of rocks as related to climbing, some knowledge of which is of the foremost practical importance to the mountaineer. The book is divided into three main parts which deal respectively with rocks, mountain structure, and features produced by erosion. The second part gives a clear explanation of the complex folded and overthrust strata of parts of the Alps.

In a wonderfully illustrated volume entitled "Il Monte Bianco" (Turin, 1926) Professor Giotto Dainelli, whose studies in the Himalaya were discussed in the *Geographical Review* (Vol. 17, 1927, pp. 138–142) deals with Mont Blanc and its immediate neighborhood on the Italian side. While the book is avowedly popular, written in a most engaging manner, it presents, nevertheless, the observations and reflections of a profound student both of physical and of human geography. Dainelli, also a great lover of mountain grandeur and of the sport of climbing, devotes several chapters to adventures among the high snows. But no less interesting to him are the people who dwell among the valleys and glens under the eastern face of Mont Blanc and the manner in which their environment is reflected in the circumstances of their daily life.

A visitor on arriving for the first time at Courmayeur sees so many buildings in the valley and scattered over the mountain sides that he gains an exaggerated impression of the density of population. Besides a dwelling house and hay barn in the village, each family is likely to have a châlet on the valley floor or mid-mountain slopes; and on the high "alps," or pastures, most of which belong to the communes, herdsmen's cabins and cattle stalls are found. The annual migration of the cattle up the slopes thus demands a quantity of buildings in relation to the population that would be altogether disproportionate elsewhere.

Families in this part of the Italian Alps are small, averaging between three and four persons, whereas in the rest of the country the average runs as high as five. Elsewhere in Italy the general rule holds that the more work done the more the land will produce, and large families are advantageous. In the mountains the agricultural ground is strictly limited both in area and productivity and can be made to yield no more than a given amount, no matter how much labor may be expended upon it. Here, therefore, large families only mean idle hands. Difficulties of communication also cause each village to live by itself and have little economic or social exchange with neighboring villages or the outside world. The native stock, consequently, has become inbred and, as is usually the case in mountain regions, has become somewhat sterile.

Isolation leads to extraordinary local pride and jealousy, which shows itself in the attitude of the mountain folk towards outsiders. "According to their psychology the world seems to be divided into two parts: on the one hand, Courmayeur and its vicinity, including Mont Blanc, and, on the other, the whole remaining part of Europe and the other continents; in the former dwell the few elect, whereas the latter are all *gardins*" (a term of contempt applied to outsiders).

ASIA

The **Autonomous Soviet Socialist Republic of Tadjikistan.** The little state which takes its name from the descendants of the once powerful Iranian people of Central Asia contains only a few of their scattered mountain-dwelling fragments, but its boundaries have been so adjusted that Tadjiks compose about 65 per cent of its population. It was created in 1924, in a subordinate relationship to the Uzbek Republic, out of the eastern portion of Bukhara, the southern part of the Samarkand Province, and the Pamir Plateau. Its area is about 135,000 square kilometers, roughly that of Czechoslovakia, which it also resembles in its irregular, elongated shape. In population and wealth, however, there is no comparison. According to various uncertain statistical computations, the population of the area in 1917 was about one million, which, in 1924, had been reduced by the casualties of civil war and by emigration into Afghanistan to about 700,000. This scanty population, with its meager resources of primitive village and nomad economic organization depleted by years of guerrilla fighting, is unable to support its own political administration, and some three-fourths of its governmental expenses have had to be covered by subsidies from the Uzbek Republic. The collection of articles, under the title "Tadjikistan" (N. L. Korzhenevski, edit.; maps and charts; Tashkent, 1925) upon which this sketch is based, were procured and published by the subsidized Society for the Study of Tadjikistan and the Iranian Peoples beyond its Borders.

It cannot be said that the survey of the country's resources and possibilities presented by these articles indicates any great prospects of development. Although the state lies in the latitudes of the mid-Mediterranean, and although some of its lower valleys at an altitude of over 400 meters afford subtropical conditions of life and support populations attaining a density of 109 per square kilometer, these districts are extremely restricted; while nearly half the total area, that composed by the Pamir Plateau, has an elevation of over 2000 meters and supports less than one person per square kilometer. The greater part of the rest is sufficiently elevated to share in the climatic and other conditions of high mountainous regions.

Mineral resources, the only possible wealth of such country, are not known to be more than mediocre. Gold is found in most of the river beds and terraces but in quantities sufficient to support only small-scale operations, having been washed out from low-grade deposits such as the Tertiary conglomerate of the northwestern Darvaz highlands; gold-bearing quartz has been discovered only in the valley of one of the tributaries of the Muk-su River. Several other minerals are present but are not known to be plentiful enough to warrant more than local exploitation such as in the primitive iron works of the Vanch valley in the middle of the country, where the smelting is done with charcoal. Coal beds of considerable extent and good quality exist in the Zarafshan basin, in the northwestern corner of the state, but are accompanied by no iron fields of any value.

The extraordinary difficulty of communication and transport, in a country of high mountain ranges and swift rivers, stands in the way of any coördination of its natural resources to produce a large-scale industrial development and restricts the exportation of raw materials. No railways penetrate the state, and none appear practicable beyond a couple of branch lines to connect the western valleys with the central Asiatic system. Even wagon roads are few and bad, but some development is possible in this respect. The only waterways navigable by steamboats are the Pyandj and Amu-Darya Rivers, which form the southern boundary, and one tributary, the Vakhsh.

Besides minerals, the principal commodities available for exportation are forest products, cattle, and hides. Forest culture presents great possibilities of development in the western half of the country. The lower and middle mountain slopes are adapted particularly to pistachio, walnut, and cedar growths. The full utilization

of these potential resources, however, calls not only for improved transportation facilities but also for scientific reforestation and conservation owing to their serious depletion in the later nineteenth century by uncontrolled exploitation. A large proportion of the middle mountainous zone (1500 to 2500 m.), which constitutes the greater part of the area of Tadjikistan, is suitable for pasturage; and cattle raising and dairying constitute the principal resource of such regions. In the western vilayets, however, this resource, like that of lumbering, is in need of conservation, since the removal of trees has resulted also in much washing away and denudation of the grass-grown slopes, diminishing the grazing areas. The insecure conditions of revolutionary years, unfavorable to the wandering occupation of sheep herding, led to a general concentration on dairy and beef cattle. The supply of horned cattle was diminished in this period but not in such serious proportions (7 per cent) as the population (30 per cent) and other live stock (e. g. sheep, 40 per cent), losses being made up by the herds driven into mountain refuges from Turkestan. The most immediate hope for the establishment of a flow of exports to offset the needed imports of manufactured articles lies in cattle.

In agriculture Tadjikistan can be little more than self-supporting, although it is capable, despite the scarcity of arable land, of maintaining more than its pre-war population. The soil, of the nature of loess, is sufficiently fertile, and the climate is not too severe to permit the raising of grain crops even in the valleys of western Gorni Badakhshan. Rainfall is inadequate, however, at these high altitudes; and irrigation of the fields is required. In the valleys of medium elevation rainfall is sufficiently plentiful and well enough distributed through the year to permit dependence upon it for most of the grain production, but irrigation is also extensively resorted to. In the lowest-lying valleys rice and cotton are grown, the latter in quantities permitting a respectable exportation.

The recent conditions of disorder brought about not only a reduction of the cultivated area but also a shift in agricultural conditions generally. Deprived of freedom of movement by insecurity and with trade largely cut off, the people concentrated in the irrigated lands, abandoning over half their rain-watered fields, and devoted themselves to more intensive cultivation of a variety of crops, in order to supply as many needs locally as possible. This change, together with the analogous shift in the proportions of live stock, indicates a movement toward a higher level of economic organization. For continued advancement, however, reform is needed in the methods of agriculture, which has been of a primitive, extensive type, resulting in soil robbery and the degeneration of irrigated areas into swamps through lack of proper water control.

All the possibilities of development of this "national home of the Tadjik people" and farthest outpost toward India of the Union of Soviet Socialist Republics lie in a somewhat problematical future. The society which has published the studies mentioned above is engaged in research into the conditions and needs of the country and its people. Another of its publications is a translation from the Persian of "Kataghan and Badakhshan," by Burkhan-ud-Din-khan-i-Kushkeki (Tashkent, 1926), which contains detailed local topographic, economic, demographic, and historical studies (completed in 1923, with numerous maps) of the Pamir region and the northern portions of Afghanistan.

J. V. FULLER

Railroad Development and Immigration in Manchuria. Manchuria of recent years has enjoyed a prosperity "unmatchable elsewhere in China." Some measure of this progress appears in papers by Mr. C. Walter Young in the *Chinese Economic Journal:* "Economic Bases for New Railways in Manchuria" (April, 1927) and "Chinese Labor Migration to Manchuria" (July, 1927). This frontier country has entered on the stage of transformation "from extensive to intensive agriculture, from hand to machine manufacture, from cart to car transportation." Already

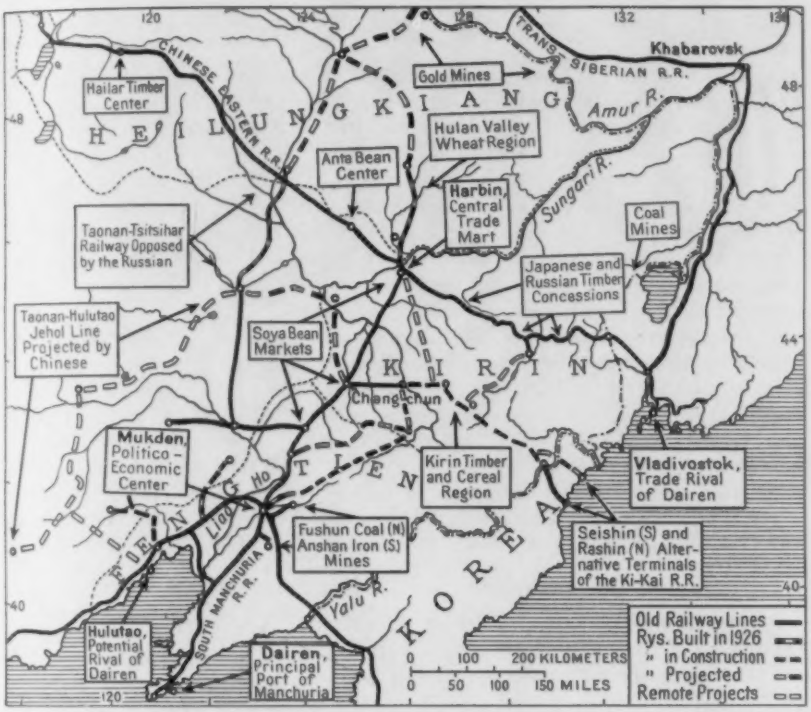

FIG. 1—Map redrawn from Mr. Young's "Map Showing the Economic Bases of the Manchurian Railway System." Scale of map approximately 1: 13,000,000.

Manchuria has more than half the railroad mileage of the rest of China—nearly 3000 miles where 30 years ago was not a rail. Some 600 miles are under construction, and projects "reasonably" sure of maturing within the next pentad would bring the total to nearly 5000 miles. Among Chinese ports, Dairen now ranks second only to Shanghai as regards total trade. Tientsin, with greater import trade, is outdistanced by Dairen's exports to Japan. Dairen furnished about nine per cent of the Maritime Customs revenue in 1925, exceeded only by Shanghai and Tientsin.

The new railroad developments are of special interest in relation to the central and northern sections of the country. Southern Manchuria, best known and most populated, is usually thought of as having great agricultural value; but in soil fertility it is inferior to the regions about Changchun and Kirin in the center and Harbin and the Sungari and Amur valleys of the north. The greatest agricultural development of the near future will probably be in Kirin; but the greatest ultimate possibilities are in Heilungkiang, now having only 12 persons to the square mile where the country as a whole has 50.

The most striking phenomenon of the present moment in Manchuria is the great wave of migration from China proper. "There is probably nowhere in the world today a migration similar in size or parallel in point of bearing on a new area of colonization and industrial exploitation."

This northward movement is not new. Even before the establishment of the Manchu dynasty in 1644 Chinese farmers had settled in the fertile Liao valley, and subsequent stringent measures to keep them from transgressing the Great Wall failed. The opening to Chinese of lands in northern Manchuria in the middle years of the nineteenth century was followed by an influx that rapidly changed their ethnic

complexion. According to the description of Abbe Huc the Chinese "burst like torrents upon Manchuria."

It is, however, since China became a Republic that the volume of immigration has increased so notably—sensationally so in the last two years. Before 1925 probably not more than 400,000 Chinese immigrated to Manchuria, and about 75 per cent of these were of the "spring come, autumn go" category. For the current immigration year, November 1926 to October 1927, it is estimated that the figure will be in the neighborhood of a million immigrants with less than half returning. The railroad development, the cheap and readily available lands, the demand of labor for the coal mines of Fushun, Penhsihu, and Yentai and for the industrial centers are responsible in some degree; but the prime cause is that in the present state of internecine warfare "conditions at home are unbearable."

The changed character of the migration is suggestive. Of the 200,000 who arrived in Dairen from Shantung and Chihli in March of this year, one quarter were women and children: in 1925 the percentage was seven. It is further suggestive that in spite of the very greatly reduced fares of the railroads and the concessions granted, only some 30 to 40 per cent travel by rail. The majority trudge along on foot the 435 miles from Dairen to Changchun. Inevitably much hardship is encountered. Governmental facilitation of immigration has been only of incidental importance and mainly opportunistic. The present great need in Manchuria is for a directive official colonization policy. The presence of a labor supply and new lands alone do not ensure economic success.

A New Irrigation System in French Indo-China. The beginning of 1926 saw the opening of a new irrigation system to water about 230 square miles in Thanh-hoa, the most northerly and largest province of Annam. An idea of the general setting of the province may be gained from a recently published work of the Société de Géographie de Hanoi, "Inventaire général de l'Indochine, Part 1: Structure et géographie physique," by Commandant Dussault (Hanoi, 1926). A detailed description of the coastal lowland is given by E. Chassigneux in "La plaine et les irrigations de Thanh-hoa," in the May, 1927, number of the *Annales de Géographie*.

The western part of the province is occupied by a series of greatly dissected plateaus pertaining to the northern end of the Annamitic chain; eastward lies the plain with which we are here concerned. There is little to distinguish it from the adjacent country of Tonkin on the north: topography, people, habitations, and costumes all are similar. The chief distinction is climatic. The mean annual temperature and especially the winter temperature are higher in Thanh-hoa; the rainy season, September to November, is more pronounced; the months from February to August are drier; and, most important, the yearly variation is much greater than farther north. In 1911 the rainfall was 47 inches; in 1907 it was 109 inches. The light rains that characterize the latter part of the cold season in Tonkin and the storms of the beginning of the warm season may be much reduced in Thanh-hoa; at times in July and August a dry föhn wind prevails from the west or southwest, the "wind of Laos." When the winter high-pressure system over the Asiatic continent develops more rapidly than usual the rainy season proper may be prematurely curtailed. These fluctuations are a serious matter in view of the density of the agricultural population on the plain—about 900 to the square mile.

The whole of the coast of Indo-China has been uplifted in recent times. The Tonkin delta is largely due to that movement. The plain of Thanh-hoa is an excellent example of a coast of emergence. Where best developed the following sequence is seen starting from the west: higher lands rising from three or four to eight or ten meters; lower lands in places only .30 to .60 meters above sea level; shore ridges, three or four meters high; a low depression often unfit for cultivation and the domain of the water buffalo; another series of shore ridges terminating seaward in a

cordon of dunes. The higher parts grow a rice crop harvested in November and in winter and spring "dry cultivations"—cotton, sugar cane, sweet potatoes, and the like; in the lower parts rice is grown as a June as well as a November crop.

It is to safeguard against the droughts which every three or four years imperil this intensive scheme of agriculture that the present irrigation scheme has been devised. It involves the impounding of waters of the Song Chu, the chief tributary of the Song Ma, and distribution over the southern part of the plain. It is expected that the increased yields will transform Thanh-hoa from a poor province to the status of an exporter. It is interesting to note that the cultivators will not pay directly for their water as is done in the Punjab. In the latter case irrigation is practiced in an arid country, where water is the only real wealth. Indo-China is a humid country and the benefits of regularizing the water supply are less obvious; the tax will be levied on property.

Explorations in Sinai. Did not Sinai dip southward to a point it would correspond very closely in area and shape to the five southern New England states. But although not large and although two historical highways—one connecting Egypt with southwestern Asia, the other the sea road through the Suez Canal and Red Sea from Europe to the Far East—run past it, until within the last decade Sinai has harbored a tract of almost unexplored country. Dr. D. G. Hogarth says of the central highlands that they constitute "the least-known and most forbidding" region in the Peninsula . . . "unmapped, ill-watered, sparsely roamed by veriest wastrels of the Arab race. During the late War it was our blindest spot in the Near East."

These words are found in Dr. Hogarth's introduction to Mr. H. J. L. Beadnell's recent book, "The Wilderness of Sinai: A Record of Two Years' Recent Exploration" (London, 1927). Beadnell's journeys were carried out in 1921–1922 for the petroleum research program of the Geological Survey of Egypt. Their purpose was to fill in a broad gap intervening between the thoroughly mapped southern and northern zones of Sinai (compare "Mapping and Exploration in the Egyptian Deserts," *Geogr. Rev.*, Vol. 16, 1926, pp. 499–500).

Beadnell's straightforward account of his experiences is of particular interest to the geologist and physiographer. Excessive barrenness renders the physiographic features of Sinai remarkably prominent. As Hogarth asks, "Where outside the moon, do cosmic bones bleach so revealed?" Whereas the southern quarter of the peninsula is a confused tangle of crystalline mountains rising to an altitude of 8681 feet in Jebel Musa—the reputed Mountain of the Law—the main relief features of the central portion are two great plateaus, one superimposed above the other and each falling off on the southeast, south, and southwest in a mighty wall of cliffs. From the rims of these plateaus both underlying strata and surface dip generally northward, causing the run-off of most of the interior of Sinai to be carried to the Mediterranean. The maximum altitude of the southern edge of the higher plateau is 5338 feet. Evidence of extensive tilting, warping, and folding may be seen east and west of the central core of the peninsula and leads Beadnell to the conclusion that "the whole of the great low-lying basin occupied by the Gulf of Suez and the Maritime Plain is either a foundered tract or an area which has failed to participate in the general upward movement of the crust." This conclusion therefore supports Professor J. W. Gregory's theory that the Gulf of Suez forms a branch of the Great Rift Valley which is said to extend from northern Palestine to southeastern Africa and of which the Red Sea trough is supposed to form a portion. (See also: H. Sadek: A Scientific Study of Scenery in Sinai, *Compte rendu Congr. Internatl. de Geogr.*, Cairo, 1925, Vol. 3, pp. 144–154.)

The final chapter of Beadnell's book recounts briefly a visit to southern Sinai, to the famous convent of St. Katharine and the wild mountains around it. Calling attention to the interminable disputes among scholars regarding the route of the

Exodus and identification of the mount where Moses received the tablets, Beadnell wisely refrains from expressing an opinion of his own. It may be pointed out in this connection that a new theory based on a detailed comparison of local topography and place names with the biblical stories has recently been set forth by Professor Alois Musil in the appendixes to his volume "The Northern Heğâz" published by the American Geographical Society in 1926. Musil locates Mt. Sinai on the mainland of Arabia southeast of the entrance of the Gulf of 'Aqaba.

The Production of Potash from the Dead Sea. The composition of the waters of the Dead Sea has long been a matter of academic interest. Recently, largely as a result of the opportunities created by the war, it has taken on a practical aspect. The Germans gave the possibilities of exploitation some thought in 1917 (Hermann Schroetter: Das Tote Meer, Vienna and Leipzig, 1924). British investigators followed, and it became a problem for the Government of Palestine under the Mandate. The proposal to grant a concession to British chemical interests for exploitation of the mineral resources is now reported in the press (*The Times Weekly Edition*, London, Aug. 18, 1927). An idea of the technical basis of the proposed industry may be gained from the series of investigations, dated 1923–1925 and entitled "Production of Minerals from the Waters of the Dead Sea," published on behalf of the Government of Palestine by the Crown Agents for the Colonies. In the summary of conclusions it is stated that "from the technical standpoint, as distinguished from the commercial, no insuperable difficulties are likely to be met with in connection with the extraction of potash from the Dead Sea in quantities of the order of 100,000 tons of potassium chloride per annum," and that "practically unlimited quantities of common salt and magnesium chloride could be produced."

The salts can be extracted by natural evaporation. Summer temperatures in the Dead Sea depression are high: the Dead Sea Post, at the northern end of the Sea registers summer temperatures of 105° F., and water temperatures of 60° C. are known: evaporation from April to September is estimated at nearly two meters. While the surface waters vary in salinity from place to place and from season to season, at a depth of 200 meters salinity is fairly constant. A suitable flat surface for evaporating tanks is found at the Dead Sea Post. This site too seems to be the most healthful available. The intense and stifling heat of the Jordan valley is here mitigated by a breeze which springs up from the Sea daily at 9 a. m. The site can be rendered free of malaria with not much difficulty, an important matter, for the Malaria Commission reports that without proper precautions for control the Dead Sea depression would prove to be one of the most malarious parts of the country. The Dead Sea Post, the only settlement, at present consists of some dozen houses whose inhabitants are occupied in the transportation of cattle and grain from the Transjordania side of the Sea. A few Bedouin from Gaza and Beersheba come into the region with their camels in winter. Labor could be recruited in part from Palestinian Arabs, and it is suggested that Jewish labor might be imported from Europe at wages which would include "an allowance for the cost of living at the Dead Sea."

The cost of transportation and the competition of the European product are beyond the scope of the report but are not less important than the technical considerations.

OCEANS

Recent Work on Iceberg Drift and Control in the North Atlantic. The scientific work of the International Ice Patrol continues to grow in interest and importance. The report for 1926 recently published (International Ice Observations and Ice Patrol Service in the North Atlantic Ocean, Season of 1926, *U. S. Coast Guard Bull. No. 15*, 1927) points out two major practical problems towards the solution of which many data are being gathered—the forecasting of the number of bergs and their

course on arrival at the critical area about the tail of the Grand Banks. The number of bergs varies greatly from year to year: in 1912 approximately 1200 bergs were reported south of Newfoundland; in 1924 only 11. Wind seems to be the most important factor governing the southward drift of polar ice and the Patrol has found the most valuable forecasts to lie in the pressure differences between Belle Isle, Newfoundland, and Ivigtut, Greenland, during the period from December to March. Value also attaches to the pressure differences between Bergen, Norway, and Stykkisholm, western Iceland, for October to January. The pressure difference directly affects the amount of field ice which, acting as a fender along the shoreward side of the Labrador Current and preventing the stranding of the bergs, in turn affects the numbers of bergs that reach the critical area. The unusual absence of field ice in 1924, for instance, left the season's crop of bergs stranded in northern waters.

The courses of the bergs in the critical area may be predicted from a current map, for the movement of the bergs is controlled almost entirely by the subsurface ocean currents. The method of mapping is found in the dynamic conception of oceanography that has its basis in the studies of the elder Bjerknes and their applications by other Scandinavian scientists. It consists essentially of the establishment of isobaric surfaces in the sea by observations of temperature and salinity (Edward H. Smith: A Practical Method for Determining Ocean Currents; *U. S. Coast Guard Bull. No. 14*, 1925. See also Mr. Smith's report in the Trans. of the Amer. Geophysical Union for 1927, *Bull. Natl. Research Council No. 61*, July, 1927, pp. 212–217). These are taken at depths of 0, 25, 50, 125, 250, 450, 750, and 1200 meters at stations 20 to 30 miles apart along five lines at right angles to and seaward of the slopes of the Grand Banks. The entire series can be taken in a few days and a map constructed for an area of many thousands of square miles.

Other work by the Ice Patrol of special interest to geographers is the use of the sonic depth finder. In 1926 no less than 465 soundings were made in the region of the Grand Banks. In connection with this a chart has been constructed showing by zones the velocity of sound in the waters of the region after corrections have been made for pressure, temperature, and salinity (see also the tables by Commander N. H. Heck and Ensign J. H. Service, "Velocity of Sound in Sea Water," *U. S. Coast and Geodetic Survey Special Publ. No. 108*, 1924).

The possibility of reducing the ice menace by destruction of the ice itself has long engaged the attention of Professor Howard T. Barnes of McGill University, who has conducted investigations on ice and icebergs from the St. Lawrence River to Hudson Bay. In 1924 while accompanying one of the trips of the Ice Patrol he was able to obtain much valuable information on the natural dissolution of bergs. Observations showed that the greatest amount of cracking and calving took place at and immediately after sunrise. During the night when the surface froze over, and during the day when it ran with water and the surface temperature was steadily maintained at 0° C., conditions were comparatively stable. This suggested that "strains could be set up at will in the great ice mass by the local application of heat at a high enough temperature to cast powerful rays into the ice." (H. T. Barnes: Some Physical Properties of Icebergs and a Method for Their Destruction, *Proc. Royal Soc. of London, Ser. A: Math. and Phys. Sci.*, Vol. 114, pp. 161–168. See also *idem:* Experimenting with Icebergs, *The Marine Observer*, Vol. 4, 1927, pp. 93–98). A suitable agent was found in thermit (a mixture of powdered aluminium and ferric oxide). This was tried out on an ice jam in the Allegheny River in the winter of 1925–1926 (Engineering Features in Breaking the Allegheny Ice Gorge, *Journ. Engineering Inst. of Canada*, Vol. 9, 1926, pp. 453–461). The following spring Dr. Barnes carried his experimentation to the Twillingate Islands in Notre Dame Bay, Newfoundland, into which drift icebergs in great numbers and of all sizes. Thermit charges were exploded on three bergs with satisfactory results, encouraging the pursuit of further study in this direction.

HUMAN GEOGRAPHY

Migrations and the Spread of Disease. "One of the great achievements of modern civilization has been to prevent the transmission from country to country of communicable diseases," says Dr. Victor G. Heiser in a paper "The Health Work of the League of Nations" (*Proc. Amer. Philos. Soc.*, Philadelphia, Vol. 65, 1926, No. 5, Suppl., pp. 1–9). There has been a strong compelling motive to this achievement, for modern civilization by developing communications between peoples has itself opened the way to the easy and rapid spread of the bad as well as the good. A striking illustration is given by Sir Leonard Rogers in "The Forecasting and Control of Cholera Epidemics in India" (*Journ. Royal Soc. of Arts.*, Vol. 75, 1927, pp. 322–355). During the nineteenth century six great pandemics of cholera spread from India to Europe, five of them reaching America. The chief route lay through the Punjab and Afghanistan. The pandemic of 1826–1837 took five years to travel from India to southern Russia; that of 1892, five months. "This may happen again at any time if nothing is done to control the spread in India itself, where severe epidemics continue to occur at irregular intervals, the causation of which has not hitherto been worked out," continues Sir Leonard. His own investigations have led him to what he believes is the climatological key to the problem, absolute humidity.

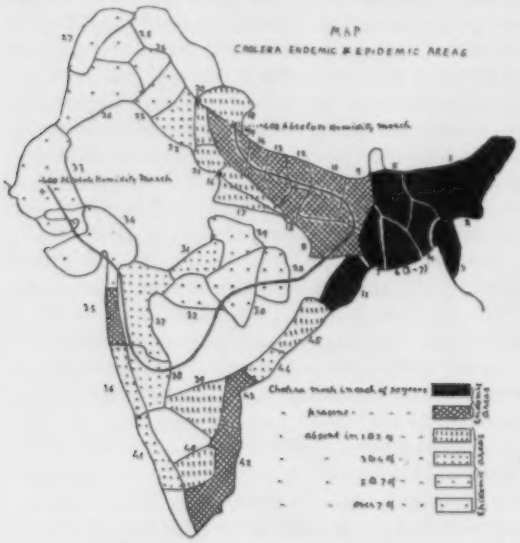

FIG. 1—Map showing cholera endemic and epidemic areas of British India, reproduced from Figure 8 of Sir Leonard Rogers' paper. Cholera is endemic in the areas shown in black and cross ruling, severer in the former; lighter tints show epidemic areas. The map also shows the .400 Absolute Humidity line for March. (Numbers on the map refer to provinces and districts.) The scale is about 1:40,000,000.

The critical value of absolute humidity (expressed as vapor tension in terms of mercury) appears to be .400, values below this being unfavorable to cholera incidence. Instead of a single endemic foyer, in India, i.e. Bengal, Sir Leonard concludes that there are three: Assam-Bengal-Bihar and Orissa and United Provinces, southeastern Madras Presidency, and a smaller area in the coastal region about Bombay. There is a recrudescence in these endemic areas with rising absolute humidity where it has been temporarily suppressed by low degree in the winter months. Increased incidence in the endemic areas is favored by deficient autumn and spring rainfall. Over the climatic factors themselves we have no control, though they can be forecast and the populace thus warned. Control, however, can be exercised over one of the chief factors in epidemics—human migration.

It is estimated that some twenty millions of people in India take part in the larger fairs and pilgrimages every year. The opportunities for infection at such gatherings are well known. Katherine Mayo's description of Benares in "Mother India" (1927) portrays vividly the difficulties of the health officer in that country. Disease is incurred not only at the gatherings but as the travelers pass through regions of en-

demic disease on their way. Cholera incidence in the Punjab is clearly related to the fairs at Hardwar on the upper Ganges. "From 1899 to 1922 every year in which cholera in the Punjab rose to .40 or more per mille the importation of the disease was traced to Hardwar pilgrims." The large Kumbh Hardwar fairs held every twelve years are attended by between one and two million people. Since 1867 each fair has been followed by serious outbreaks except in 1891, a year when absolute humidity conditions were distinctly unfavorable. A sanitary report on the Central Provinces in 1913 says "only four times in the last 45 years has the province escaped cholera, and in the vast majority of cases these outbreaks have been traceable to fairs, e.g. epidemics have been traced 15 times (chiefly in recent years) to Jaganath Puri, 8 times to Allahabad, 6 times to Pandarpur and 13 times . . . to small provincial fairs." Anti-cholera inoculation is the remedy suggested.

The subject of pilgrimages cannot be passed over without reference to Mecca. The pilgrimage of this year (1927) is reported to be the largest on record as far as overseas pilgrims are concerned, the number being estimated at about 130,000. (The progress of the pilgrimage may be followed in contemporay numbers of *The Near East and India.*) Their health is safeguarded by the quarantine stations on two islands about seven miles south of the port of Jidda. The stations are under the medical department of the government of the Hejaz and are reported to be excellently equipped. Pilgrims from the Netherlands East Indies, who constituted 50 per cent of the 1927 attendance, and from India, 20 per cent, pass quarantine at Kamaran Island, at the southern end of the Red Sea. An "Agreement Between the United Kingdom and the Netherlands Regarding the Sanitary Control over Mecca Pilgrims at Kamaran Island," signed at Paris June 19, 1926 (Treaty Series No. 26, 1926), established most thorough-going provisions for the efficacious treatment of pilgrims. Under one of the clauses the government of India undertakes to communicate to the Far Eastern Epidemiological Bureau at Singapore information regarding cases of plague or cholera which have manifested themselves.

The Bureau at Singapore is an establishment of the League of Nations. Its locale is well chosen: "Not only does it form the 'gateway' for shipping to and from the Far East, but it lies at the very centre of maritime communications between ports of countries which, from an epidemiological point of view, are of world-wide importance. In short, the health conditions and quarantine arrangements at Singapore are matters of very considerable international concern" ("Prevalence of Epidemic Disease and Port Health Organisation and Procedure in the Far East," Report presented to the Health Committee of The League of Nations by F. Norman White (C. H. 130)). The Malaria Commission is another important activity of the Health Section of the League. After the war there was a great incidence of this widespread disease in Europe. The Commission undertook in 1924 a tour of investigation of those European countries directly affected by the war where the disease is endemic—the Balkans, Rumania, Russia, Italy (League of Nations Health Organisation: Report on the Tour of Investigation of the Malaria Commission in Certain European Countries in 1924 (C. H. 273), Geneva, 1925). The Commission stresses the fact that malaria is a social disease and that mass movements of the population are of prime importance—movements of troops, of refugees from war and famine, of agricultural workers. A later tour of investigation in Spain likewise emphasizes the migration factor, citing the cases of pepper cultivation and *transhumance* in Estremadura, the harvest in Andalusia, and especially rice cultivation in Valencia and the Ebro delta (See the summary "El paludismo y la lucha antipalúdica en España," *Iberica*, Vol. 27, 1927, pp. 2–6).

Another major project of the League deals with Central Africa's problem of sleeping sickness. The League's interest led to an International Conference on Sleeping Sickness in London in 1925, at which it was recommended that an international committee be appointed by the League to deal with the matter. The case of other

diseases also merits attention. In his report on "Labour in the Tanganyika Territory" (Colonial No. 19, 1926), Major G. St. J. Orde Browne says "Malaria and some other ailments are already fairly evenly distributed about the territory, but there are certain diseases such as hookworm and spirillum fever that are much more limited in occurrence, and these are being steadily spread by the present lack of system in travel control whereby previously uninfected tribes are exposed through the return home of labourers from areas of infection." He mentions two instances where labor is drawn from a distance of six to seven hundred miles, the journey being made on foot.

In a paper "L'organisme humain et le milieu biologique naturel," (*Bull. Soc. de Géogr. de Lille*, Vol. 68, 1926, pp. 105–113, 146–161) Maximilien Sorre of the University of Lille quotes several instructive instances of man's part in the spread of disease, among others the spread of sleeping sickness in the Congo as a result of the opening up of Africa. He concludes: "The progress of relations and especially the conquest of the world by Europeans beginning with the sixteenth century have contributed to aggravate the influence of the *milieu*, and without doubt it attained its maximum towards the end of the nineteenth century. But today, on the contrary, the progress of the biological sciences and their practical applications tend to limit it and to make for its progressive disappearance." In this note we have mentioned a few instances from one chapter of the new medical geography; the complexity of the whole subject of the reactions between man, his health and his environment M. Sorre shows well in his interesting and suggestive paper.

HISTORICAL GEOGRAPHY AND HISTORY OF GEOGRAPHY

Jodocus Hondius' World Map on Mercator's Projection, 1608. The small maps in the atlases of Mercator, Ortelius, Hondius, and Blaeu, of the famous Dutch school of cartographers of the late sixteenth and early seventeenth centuries, are fairly well represented in libraries and private collections, but the more perishable, large wall maps have become extremely rare. In 1919 the Royal Geographical Society acquired the only known copy of Jodocus Hondius' world map of 1608 on Mercator's projection. A collotype reproduction of this in twenty-five sections and an index sheet was published early this year. Specially made paper was used, and exceptional care was taken in every respect. The result is exquisitely clear and attractive. The reproduction is accompanied by a scholarly memoir by Mr. Edward Heawood, Librarian of the Royal Geographical Society.

Jodocus Hondius (or Josse Hondt, 1563–1612), as was customary in his time, had no scruples against borrowing ideas, or even copying without acknowledgment, from the works of predecessors. For the map of 1608 he used maps by Mercator as well as a world map of Petrus Plancius, 1592, of which the one copy now known has not as yet been reproduced. Heawood points out that "it is perhaps as a work of art that the map [of Hondius] . . . most claims our admiration. But in this field it had at least one predecessor of almost equal merit, Blaeu's big map of 1605, the influence of which is obvious." The latter was reproduced by the Hispanic Society of America in 1914, with accompanying text by Dr. E. L. Stevenson.

The rectangular panel of the map proper is surrounded by a series of circular and oval vignettes in which figures supposed to represent the natives of the various countries of the world alternate with plans and views of important towns. Oceans and unknown land on the map surface itself are covered with drawings: ships and marine monsters fill the seas; a magnificent group of allegorical figures personifying the continents occupies northern North America. A row of heads representing Ptolemy and the four circumnavigators, Columbus, Drake, Candish or Cavendish, and Van Noort, fringe the margin of the Austral continent. Below the head of Ptolemy is a small map showing what Hondius believed to be the range of the for-

mer's geographical knowledge, and below each of the circumnavigators is a similar small map representing his route.

A long disquisition on the geography of the world given below the map panel was copied almost word for word from Plancius. Legends are scattered here and there, many of which Heawood translates. One explains a graphic method, which Hondius claimed himself to have devised, for constructing cartographic grids on Mercator's projection; another gives a rule for measuring distances on maps drawn on Mercator's projection; another presents an argument on the superiority of Hondius' map over the average sea chart; and an exceptionally interesting passage deals with the winds of the Pacific Ocean.

Heawood asserts that, "as regards the general geographical details, Hondius shows no marked divergence from his contemporaries." The huge southern continent which figures so prominently on the maps of Mercator and others and persisted until the eighteenth century (see Armand Rainaud: Le continent austral, Paris, 1893) also bulks large on Hondius' map of 1608. On the other hand, the four fabulous islands which Mercator placed in the Arctic regions are not shown. Contemporary discoveries by Barents, Davis, and Hudson in their search for the Northwest and Northeast Passages, however, are indicated. Although Mercator's exaggerated longitudinal extension of Europe and Asia is considerably reduced, the length of the Mediterranean Sea is overestimated—an error dating back to Ptolemy—and, as a result, Italy is warped out of shape. China is represented in part on the basis of information acquired in the sixteenth century, but northeastern Asia still bears the traces of Marco Polo and Ptolemy in its place names. In North America the St. Lawrence is the principal river, but there is no sign of the Great Lakes.

A large world map on the stereographic projection by a certain Jodocus Hondius was reproduced under the joint auspices of the American Geographical Society and the Hispanic Society of America in 1907. Mr. Heawood suggests why the date, 1611, ascribed to this map by its editors, Dr. E. L. Stevenson and Father Joseph Fischer, S. J., is not altogether certain. The map may have been the work of the younger Hondius.

Some Recent Geographical Bibliographies, with a Special Reference to the History of Geography. Volumes 40 (1924–25) and 41 (1926) of the *Geographisches Jahrbuch*, edited by Dr. Hermann Wagner, have recently appeared. We wish here to call particular attention to the summary of recent progress in the field of history of geography since the middle ages by Professor Konrad Kretschmer of Charlottenburg. Students of the history of medieval and modern geography for some years have been hampered by the lack of recent bibliographical aids compiled to meet their special needs. Professor Kretschmer's review brings up to date the similar reviews by Sophus Ruge and Walter Ruge in earlier numbers of the *Jahrbuch*. After a section on the history of geography and cartography in general (in which, by the way, attention is called to the fact that no broad, general history of our science has been written since O. Peschel's work, published in 1877), subdivisions follow devoted to the early Middle Ages, the work of the Arabs and other Orientals, the Scholastic Period, the Period of the Great Discoveries, and the so-called "Age of Measurements" (*c.* 1650 on).

Another extremely useful aid to studies in the history of geography has likewise appeared within the last year: Dr. George Sarton's "Introduction to the History of Science, Vol. 1: From Homer to Omar Khayyam," *Carnegie Instn. Publ. No. 376*, Washington, 1927. As fortune would have it, this volume is in the main devoted to the ages before the period covered by Kretschmer. Sarton, envisaging science as a unit, endeavors to give a survey of its development throughout the whole world. His method seems somewhat peculiar at first sight. His conception of the subject is so broad, however, that the method is probably the best that could have

been devised. In each chapter the author presents a cross section of the state of science in every civilized region at a particular time. Thus, if we read continuously, we constantly jump from Rome to Greece, from Greece to Mesopotamia, from Mesopotamia to India, from India to China, and occasionally we clear the entire stretch from the Western Mediterranean to the Far East in one leap. The first four chapters are devoted to the period between the ninth and the end of the fifth centuries before Christ; Chapters 5–34 cover a half century apiece. Each chapter opens with a general statement showing the relation of the contemporary developments both to one another and to previous growth. These introductory statements are very skillfully worked out and written with a light touch, refreshing in a work of such erudition. They serve as a corrective to what might otherwise seem an over-artificial chronological arrangement, and they make it possible for the specialist to gain some idea of the manner in which the evolution of the particular subject in which he is interested is related to broader movements. After each of these general summaries brief estimates are given of the developments in the various fields of science, and these, in turn, are followed by short sections on the work of individuals, with extensive bibliographical references. The bibliographies, indeed, are perhaps the most useful feature of the entire publication. Titles of texts, translations, and modern studies are listed, often with illuminating comments. In this connection Sarton has used much of the material that he has been incorporating in the critical bibliographies of the periodical *Isis*, founded by him in 1912 and now the organ of the History of Science Society.

If space permitted, one would be tempted to discuss at length some of the many points of unexpected interest brought out in Sarton's volume. For instance, in the section devoted to the first half of the tenth century, a time when science in Christendom was at a very low ebb, no less than eleven oriental geographers (ten Moslem and one Chinese) are listed. The quantity and quality of geographical work done by the Chinese from very early times is a revelation. Thus, at the end of the eighth century after Christ, Chia Tan drew a "Map of China and of the Barbaric Countries Within the Seas." Sarton believes this to have been the first large-scale map of an extensive area ever constructed. "It was 30 feet long and 33 feet high and on a scale of one inch to one hundred li" (about one inch to twenty miles).

GEOGRAPHICAL NEWS

"Antiquity": A Quarterly Review of Archæology. The first number of the new magazine *Antiquity* appeared in March of this year, under the editorship of Mr. O. G. S. Crawford, Archæology Officer of the Ordnance Survey of Great Britain. The magazine aims "to summarize and criticize the work of those who are recreating the past" and this on a broad basis not confined "too rigidly within the conventional limits" for "the past often lives on in the present." The aim has been well filled in the two numbers already issued.

The March number opens with an article by the editor on "Lyonesse," the legendary land between the Scilly Islands and Cornwall, of interest to the student of coastal changes. Among other papers in the number are "Orientation," by Vice-Admiral Boyle-Sommerville; "Maori Hill-Forts," by Raymond Firth; and "The Danube Thoroughfare and the Beginnings of Civilization in Europe," by V. Gordon Childe. The volume for June includes "Where did Man Originate?" by E. A. Hooton; "Place-names and Archaeology," by A. Mawer; "The Etruscans," by D. Randall MacIver; "The 'Works of the Old Men' in Arabia," by Flight-Lieutenant Maitland; and "The Aryan Problem—Fifty Years Later," by A. H. Sayce.

OBITUARY

EDUARD BRÜCKNER. The death of Eduard Brückner in Vienna, May 21, 1927, at the age of 65, means a severe loss to three sciences: geology, meteorology, and

geography. One of Albrecht Penck's early students at Munich, Brückner contributed the first monograph published in Penck's *Geographische Abhandlungen:* a study of the glaciation of the Salzach region on the boundary between Bavaria and Austria. In 1888 Brückner became professor of geography at Bern; he held this position until 1904, going in that year to Halle and in 1906 to Vienna as Penck's successor in the chair of Physical Geography, which he occupied until his death.

Brückner's work was both original and precise. His outstanding contributions were in two main fields, meteorology and glacial geology. His well known discovery of a climatic cycle of thirty-five years within which warm, dry years alternate with cold, wet years was set forth in detail in 1890 in an elaborate monograph entitled "Klimaschwankungen seit 1700." Discussing the Brückner Cycle at a joint meeting of the Association of American Geographers and the American Meteorological Society in Philadelphia, December 30, 1926, Dr. Alfred J. Henry asserted that the "reality of the cycle has not been seriously questioned."

Brückner participated in the American Geographical Society's Transcontinental Excursion of 1912 and is remembered for his winning personality. In an article contributed to the Memorial Volume of the Excursion he endeavored to correlate the history of settlement in the western United States with climatic oscillations. Brückner's work in glaciology is also significant. He collaborated with Penck in the authorship of "Die Alpen in Eiszeitalter" (3 vols., 1909), the fundamental study of the advances and recessions of the Pleistocene ice in Europe, and in 1906 he founded the international journal, *Zeitschrift für Gletscherkunde.*

Sir HARRY HAMILTON JOHNSTON. Sir Harry Johnston died on July 31 at Woodsetts, near Worksop, England, in his sixty-ninth year. At the age of twenty-one in Tunisia he entered on the career that has left its mark on Africa. From that date until the beginning of the present century he was almost continuously in Africa. It was the time when the scramble for that continent was in full swing, and Sir Harry contributed his full share to the acquisition and maintenance of British territory. In 1882 he joined an expedition to Angola whence he proceeded alone to the Congo, there meeting Stanley. "The River Congo" was published in 1884, and he later made use of his own experiences as a background to "George Grenfell and the Congo" (1908). On his return to England he was invited to lead the Kilimanjaro Expedition of scientific and political import ("The Kilimanjaro Expedition," 1886). The next three years were spent in consular services on the Guinea Coast and then in Mozambique, which in turn led to Nyasaland and six years of excellent work as Commissioner and Consul General of that territory ("British Central Africa," 1897). After two years in Tunisia again Sir Harry was appointed Special Commissioner of Uganda. A splendid memorial to his versatile genius is to be found in the two volumes based on his experiences there, "The Uganda Protectorate (1904)," with a wealth of paintings, drawings, and photographs of birds, beasts, and people. It was during his stay in Uganda that he discovered the okapi. In 1899 "A History of the Colonization of Africa by Alien Races" was published; it became a standard work, and a revised edition appeared in 1913.

Sir Harry had pronounced sympathies with the natives; in fact the *Westminster Gazette* refers to him as "one of the greatest benefactors of the African races." This interest led him to visit the United States and the West Indies and record his observations in "The Negro in the New World" (1910). Undoubtedly the scientific work that lay nearest his heart was the "Comparative Study of the Bantu and Semi-Bantu Languages" (Vol. 1, 1919; Vol. 2, 1922), a monumental work of permanent value and a life task that he was happily enabled to complete. A list of his major writings is given in his entertaining and readable autobiography "The Story of My Life" (1923).

GEOGRAPHICAL REVIEWS

Civil Aviation in Europe

Grosser Luftverkehrs-atlas von Europa. Bearbeitet und herausgegeben unter Mitwirkung der Wissenschaftlichen Gesellschaft für Luftfahrt E. V. (WGL), Berlin, und unter Benutzung des Materials der Deutschen Luft Hansa A. G., Berlin. 1 and 202 pp.; maps, ills. Verlag für Börsen- und Finanzliteratur Aktiengesellschaft, Berlin and Leipzig, 1927. M. 25. 13 ½ x 9 ½ inches.

The Approach towards a System of Imperial Air Communications: Memorandum by the Secretary of State for Air, laid before the Imperial Conference, 1926, together with the Report of the Imperial Air Communications Special Sub-Committee. xiii and 91 pp.; maps, diagrs., ills. H. M. Stationery Office, London, 1926. 5s. 13 x 8 ½ inches.

The preliminary text of the "Luftverkehrs-atlas" reads not unlike a railway or steamship guide. After lists of airdromes and air routes there follows a comprehensive table of passenger fares and surcharges for baggage. Some of the fares converted into dollars, with flying times, are as follows: London to Paris, $25.50, 2 hrs. 30 mins.; Berlin to Munich, $25.00, 4 hrs. 15 mins.; Berlin to Moscow, $71.40, 12 hrs. 50 mins.; Stuttgart to Zürich, $8.30, 1 hr. 10 mins.; Toulouse to Dakar, French West Africa, $190.00, 47 hrs. 10 mins. Next comes a statement of the conditions under which passengers and freight may be transported, with explanations of the requisite tickets and passports. The companies assume no responsibility in case of accident, but passengers are insured by the Deutsches Luft Hansa without increase in fare. Customs regulations and rules governing the sending of letters and packages by air mail are given at length.

Detailed descriptions are provided of the airdromes and landing fields of Europe. In each case a short article, something in the style of Baedeker, tells about the nearest large town and its principal points of interest. Then data are furnished relating to the landing field: specific facts regarding its ownership and control, its topographical position, its altitude, its geographical coördinates, its means of communication with the neighboring town, its meteorological station, facilities for the accommodation of passengers at the field itself, addresses and telephone numbers of the nearest doctors and hospitals, and a table of the distances to various near-by points.

The entries concerning the meteorological stations suggest the high degree of efficiency to which this service has been developed. To nearly every German airdrome one or more trained meteorologists are assigned. Local observers, for the most part postal employees, stationed at intervals of 50–100 kilometers along the air routes, send in telegraphic reports on weather conditions about an hour before the start of each flight. In addition, emergency observers give warning of the unexpected appearance of storms, fog, or other adverse conditions. Through the information thus gathered the meteorologists at the airdromes are able to furnish definite local forecasts and, if necessary, to recommend different routings. (See Harry Paech: Der deutsche Luftverkehr, *Petermanns Mitt.*, Vol. 73, 1927, pp. 13–18, reference on pp. 16–17.)

The maps are of two sorts, general and local. The general maps, on a small scale (mostly 1:1,000,000), show the air routes on which regular service is provided. In addition, numerous features of special interest to the aviator are indicated: the positions of airdromes and landing fields, radio stations with masts over 70 meters high, lighthouses, lightships, danger zones (particularly artillery practice or proving

grounds, and balloon or kite stations), and areas prohibited for military reasons. The local maps, on a scale of 1:75,000, indicate the positions of landing fields in relation to cities. There is hardly a German town of any considerable size that does not have its field. German municipal authorities are eager to bring air service to their cities, as they wish to avoid a grave mistake made by some of their predecessors. The latter "when railways were first built frequently would have nothing to do with them. The evil resulting from this short-sighted policy was felt at a later date and, indeed, is evident in places even today, since many cities can now be reached only by branch lines, while the world's commerce passes by, far from their walls" (Paech, *op. cit.*, pp. 15–16).

The "Luftverkehrs-atlas" shows us something of the way in which the Germans, lacking colonial possessions, have constructed a closely meshed, highly organized network of air routes within their home country. British interest is primarily concerned, rather, with the development of long-distance airplane and airship communications throughout the Empire. This is made evident by the Air Ministry's document cited above. Here, among clear, non-technical discussions of widely varying phases of peace time aviation both as it has grown in the past and as it may be expected to evolve in the near future, may be found much of geographical interest, particularly regarding problems of navigation, instruments, aerial surveys, and the adaptations of routes to broad, permanent climatic as well as to local, temporary meteorological conditions.

Sir Samuel Hoare, Secretary of State for Air, asserts in his Memorandum that aviation "is one of the most effective instruments for stopping the waste of time that is now undermining the vitality and retarding the development of Empire intercourse." Regular service is contemplated in the near future between Cairo and Karachi in northwestern India, as the first link in a future air route that will join with England, Australia and the other far eastern parts of the Empire. Similarly, an experimental service between Khartoum and Kisumu in Kenya Colony is planned as the first link in a Cape-to-Cairo route. These projected main trunk lines will be fed by branches from neighboring colonies. Among the many interesting maps in the Memorandum reference may be made to one of the "England-India Airship Route showing meteorological stations from which observations are circulated daily, and high land which airships will normally avoid."

There is no doubt that aviation is rapidly becoming recognized in Europe as one of the well-established elements in the mechanism of transport and communication. Increasing public confidence is indicated by the fact that insurance charges are much less when freight is shipped by air than by rail or steamer. Despite the splendid work of our Air Mail, aviation in the United States has not reached this advanced stage. A partial explanation may be found in our failure to encourage aeronautic enterprise by government subsidies.

Meteorology in History

Sir Napier Shaw. **Manual of Meteorology, Vol. 1: Meteorology in History.** xx and 339 pp.; maps, diagrs., ills., bibliogr., index. The University Press, Cambridge, 1926. 30s. 10½ x 7½ inches.

This admirable manual by Sir Napier is growing backwards but growing so well that we are impatient to see the complete work. It is to be in four volumes, and the final proof of Part IV was given to the press on Armistice Day and soon published, while Part I has but recently appeared. Parts II and III are promised for the early future.

Meteorology, in the sense of a study of the weather, developed more or less independently with many savage races in the forms of imitative magic and earnest prayers, designed to control the weather or obtain the kind desired. Progressive culture

eliminated the medicine man, but the weather went on. Then it was realized that while the storm could neither be coaxed nor scared, nor rains had for the asking, there are forerunners—signs, they called them—that give evidence of what to expect during the next few hours. Elijah told Ahab to hurry and eat and get down from Mt. Carmel "for there is a sound of abundance of rain." And thus in every part of the civilized world

> "Men judge by the complexion of the sky
> The state and inclination of the day."

This is an important phase of meteorology and deserves more intelligent attention than commonly is given to it.

Sir Napier's first volume takes us from the earliest known comments on the weather down through the heyday of weather signs, to the beginning of coöperative, or map, meteorology, in which forecasting the weather for one place is based on telegraphed reports of the existing weather at other places. Here and there, however, to complete a topic, something of more recent observations and theories is introduced. Thus, an excellent summary is given at the outset of the climate today of all those portions of the world known to the ancients, exclusive of China. This enables us better to understand classical allusions to the climate and the seasons and to judge whether or not marked changes have occurred in the climates of these regions within historic times. Sir Napier does not decide this question for us but gives several interesting quotations, pro and con, and leaves us to decide for ourselves, though intimating that the evidence suggests that on the whole the climatic changes within historic times have been only minor fluctuations of short duration.

In discussing the history of a science it is difficult to know where to stop, because it somehow ties up with everything else; and so, under the topic "meteorology" Sir Napier has given us an account of the calendar and the measuring of time. These are not strictly weather subjects, perhaps, but their inclusion is justifiable; and besides they are discussed exceedingly well.

An excellent account of the state of meteorological knowledge in the classical days of Greece is given by comments on and quotations from the works of Aristotle and Theophrastus. In the main this may also be regarded as a summary of the state of meteorological knowledge for more than 2000 years—the twenty centuries and more during which this and every other science was regarded as fully explained by Aristotle, when to quote him was to silence discussion and inquiry, and to doubt him intellectual sacrilege.

The longest chapter in the book gives brief biographical accounts of the seventy-four scientists who previous to the introduction of the weather map had added most to our knowledge of the air and its ways. Two of these, Francis Bacon and Galileo, made their contributions before the invention of the barometer. Only five were Americans—Franklin, Espy, Maury, Loomis, and Ferrel. One of the two full-page group pictures of international meteorological conferences shows only two Americans, Rotch and Page, neither connected with the official meteorological service; in the other, America is without representation. These facts are not flattering, nor is the situation improving. Meteorology, except the kindergarten variety, is practically ignored by our educational institutions. In professing to teach meteorology without a good previous knowledge of mathematics and physics, as so many do, they put themselves, in this respect, in the same class as that much-advertised electrical school that pretends to make of "anyone" a master electrician in a few weeks without books and without lessons!

Two interesting chapters are devoted to the weather elements, and methods of recording them, of the lower and the upper air respectively. Each of these topics, especially the latter, is very modern; yet it has a history, and that is given, but with practically no reference to the physical problems involved—that important part

being left for the other volumes. The chapter on the upper air contains seventy-six small, but happily selected and excellently reproduced, cloud pictures.

The more difficult and less common measurements, those that involve the refinements, care, and accuracy of the laboratory, are listed in a separate chapter. These include the measurements of solar radiation, integrally and part by part; terrestrial radiation; atmospheric absorption and visibility; dustiness; lightning; and the electric and magnetic fields of the earth. Here too, as elsewhere, there are no instructions that would guide the observer, no detailed description of the apparatus, nor discussion of the problems these instruments help us to solve; they are without the scope of this volume. The various methods of representing meteorological and climatological data numerically and by charts and graphs are briefly discussed, sufficiently for the general student. The needs of the specialist cannot be provided in a book; he must consult monographs and a library.

In short, this first volume is essentially a history of meteorology, in which properly the science appears only incidentally, and then with but little allusion to physics and practically no use of mathematics. It therefore can be read by almost every "meteorologist," and should be. It would be vastly more to the point, however, if they, especially the "teachers" of meteorology, also could read understandingly every page of the other volumes, for they will treat of the science—a science but little known, unfortunately, to many that profess it.

W. J. HUMPHREYS

THE PROBLEM OF CIVILIZATION

ELLSWORTH HUNTINGTON. **The Pulse of Progress, Including a Sketch of Jewish History.** vi and 341 pp.; maps, diagrs., bibliogr., index. Charles Scribner's Sons, New York, 1926. $5.00. 9½ x 6½ inches.

Readers of the *Review* are so familiar with the work of Ellsworth Huntington that a new book by him calls for no introductory comment. It needs but be stated that in this, his latest work, we are promised a summary of the most important principles advocated in his previous writing; and, while this is true, the reader need not expect a mere restatement of old materials, for, on the contrary, the author illustrates these principles by putting them to new and, in some respects, novel tests. It is well, however, to note that the keynote of the book is to "show how the workings of these factors are connected with one another and with cultural changes; and third, to discuss a few examples which show how physical environment, biological inheritance, and cultural progress have worked together to produce the fluctuations of history" (p. 2). But this is not the whole story, for the work is so planned as to be a non-technical and readable presentation of the subject.

Turning now to the body of the book, we are introduced to the discussion by a preliminary orientation in the growth of culture groups, which are said to rise and fall, or to progress from inception to full vigor, and then decline to extinction. The author characterizes these phenomena as pulsations, though not periodically rhythmic. It is the irregularity of these pulsations that urges him to seek environmental causes and to look, first of all, for climatic shifts affecting the food supply.

After pointing out a suggestive correlation between periods of drought and economic cycles, the author checks the distribution of distinguished men against the distribution of land values, finding that the productive regions attract the ablest elements in the population. Involved in this is the question of migration, and the biological origin of these distinguished men is analyzed, the outcome suggesting that the ablest elements of the population tend to segregate in the most favored localities. Cities are then reviewed as indices of ability and wealth. Space does not permit enumerating all the points brought out in these first chapters, which are, for the most part, specific inquiries in selective migration within the United States and a study of nomadism in the Old World as a sifter of abilities and a developer of aggressiveness.

The author turns next to problems of climate, one chapter being contributed by Dr. G. C. Simpson, Director of the Meteorological Office. This section traverses ground covered in the author's earlier work but is given here in more concise form and in the clarified judgment that comes with time and reflection. The outcome is fairly put by the author, as showing that climatic changes and cycles are coincident with migrations of peoples and that there are observations, distinct from his own assumptions that one is the cause of the other. The discussion is rounded out by a résumé of the author's earlier conclusions as to the origin of race individuality, concluding that the initial causes are biological. On the other hand, the causes that disturb the stability of peoples, that sort out various grades of ability and temperament, are regarded as climatic and geographical.

The latter half of the book contains a novel and interesting study of the Jews, the historical materials being taken, for the most part, from the Bible and then correlated with geographical and climatic data for their habitat. In one sense, this is an ecological study, but what is most in evidence is an attempt to state the history of the Jews in terms of geography, climate, and the principles of interpretation developed in the first half of the book. To the naïve reader, this sort of treatment of the Bible, as the explanation of the successive plagues in Egypt, the reasons why the faithful were so long reaching the Promised Land, and the final isolation that intensified and set the religious passion of that people, will be little short of amazing. The author's treatment is also eugenical, since he makes a strong case for the relatively large number of great men appearing at every crisis in the history of the Jews, as due to the isolation of the people and inter-family crossing.

Whether all the interpretations offered are correct or not is a minor matter—the writer puts these forward as suggestions; but his treatment of Jewish history is a stimulating example of how geography should go hand in hand with studies of culture. That this section of the book will be vigorously assailed, goes without saying. Anyone who even hints at an external determiner in culture and in history rouses the resentment, not only of the orthodox Jew and Christian, but of a large scientific and scholarly faction with whom the immutability and freedom of man's social behavior is a fundamental doctrine. To all such, these chapters will sound sacrilegious; yet, one great value of the book, as a whole, is its vigorous challenge to the fundamentalist in religion and the self-determinationist in culture.

The volume closes with a brief comment on Russia and a running discussion of the tropics and the subarctic as unlikely places for future civilizations. In this section, as indeed throughout the book, emphasis is laid upon the biological selection that goes along with shifts in population. Many data are cited to show that migration is not random sampling, but that the sample is weighted; under one set of conditions, the sample will be high grade, another time, low grade, etc. Almost everyone agrees to this, even those who deny there is any such thing as heredity.

In many ways this is one of the author's most forceful books and should be welcomed by the intelligent reader. Such a reader is sure to close it with new problems in mind, and that is about the best that can be had from a book. The critical will feel that the author pushes his inferences to the very limit of the data; but it is the reader's privilege to choose his own distance, as the author has intimated.

CLARK WISSLER

THE TRANSCAUCASUS REGION

ANTON BÜDEL. **Transkaukasien: Eine technische Geographie.** 152 pp.; maps, bibliogr., index. *Petermanns Mitt. Ergänzungsheft No. 189*, 1926.

Of all the newer political divisions that have resulted from the war and the successive treaties that followed it, none is perhaps worse off from the standpoint of reliable statistical data than the Transcaucasus region. There had to be considered in the

first instance, in 1919, the three republics of Georgia, Azerbaijan, and Armenia. The Armenian boundaries were indefinite, though provision had been made in the Treaty of Sèvres, eventually discarded, for a boundary between Armenia and Turkey to be drawn by President Woodrow Wilson. Direct negotiations between Turkey and Russia resulted in a new boundary (Treaty of Kars) farther north than the old one established in 1878 and valid until 1914. By this treaty Kars, Ardahan, and Artuin were restored to Turkey. When the Transcaucasus was overrun by the Red army in 1921 and the governments reorganized, three principal political divisions of Georgia, Azerbaijan, and Armenia were formed into a regional union of Soviet Socialist Republics. In addition, a number of autonomous governments were established, both in the Transcaucasus and in the Northern Caucasus, so-called, north of the Caucasus Mountains.

With all of these changes the statistical sources generally available give one no aid in arriving at a picture of the resources of the country, the distribution of people, and the outstanding economic and social problems of the time—hence the importance of Dr. Büdel's monograph. He has made of it a compendium of broad scope, not omitting to state even the technical facts of astronomical observation, triangulation, and survey upon which the maps of the region depend; nor the geodetic observations, the geology, and the minutest details of climate, hydrography, etc. With the physical bases of geography laid down, he proceeds to a description of population distribution and capacity, the colonization of the country, the forests, agriculture, grazing, horticulture, fisheries, industries, transport and commerce in a thoroughgoing manner and with his statistics grouped by present political divisions so that they are at last in flexible form. Though his maps and statistics relate to the Transcaucasus as of 1914 so far as the Turkish boundary is concerned, the details are classified according to districts so that combinations are easily made which permit one to derive whatever facts are desired for a political group that may be in question. The region has a wide diversity of physical conditions and resources, and at the present time it is minutely subdivided by political lines. From the geographical standpoint these lines are of limited importance.

In Dr. Büdel's table on pages 99–100 giving the amount and transport routes of the different commodities of the Transcaucasus he has supplied us with a picture of the whole commerce of the region that is most valuable. It is shown how small is trade between the Transcaucasus and Asia Minor in contrast with the significant exchanges between Persia and the Transcaucasus. To Persia sugar, petroleum, metals, textiles, and food products go in large quantities; and from Persia come rice, fruit, wool, carpets, and grain. Baku is a great center of exchange with central Asia. Through the port goes a great variety of products of Russian origin; and out of it are sent petroleum products, rice, metals, sugar, food products, tea, most of which have been transported to Baku from central Asia. The author has even given the hydrographic measurements in such limited detail as they exist of the principal streams of the region and calculates the amount of energy that may be derived therefrom and their value in irrigation and industry. There is a bibliography of 212 items.

Lawrence on Arabia

T. E. Lawrence. **Revolt in the Desert.** xvi and 335 pp.; maps, ills., index. George H. Doran Co., New York, 1927. $3.00. 9 x 6½ inches.

This is not the place to add to praises heaped by a host of literary reviewers upon this remarkable book. Our interest in it here is solely geographical. And "Revolt in the Desert" is indeed a work of no little geographical value, even though geography as such may have been far from its author's thoughts. His aim was to tell the story of the Arab rising, and he doubtless purposely omitted topographical explanations that might bore the reader. This, together with the small scale of the map, often

makes it difficult to follow the movements of troops and tribes. In his dramatic marches and countermarches Lawrence crossed some tracts of virtually unknown country, but he gives us no precise details regarding them. Nor was he in the least interested in "scientific" systems of transliterating place and personal names; when the publisher pleaded that it might be well to spell the same name consistently, he wrote back: "I spell my names anyhow, to show what rot the systems are." This rather disarms criticism.

The geographical value of "Revolt in the Desert," therefore, springs not from any conscious effort on the part of the author. The Arab campaign was an extraordinary example of the successful adaptation of military strategy to the particular problem that had to be solved—in this case a problem preëminently geographical.

"The Arab war was geographical, and the Turkish Army an accident. Our aim was to seek the enemy's weakest material link and bear only on that till time made their whole length fail. Our largest resources, the Beduin on whom our war must be built, were unused to formal operations, but had assets of mobility, toughness, self-assurance, knowledge of the country, intelligent courage. With them dispersal was strength. Consequently we must extend our front to its maximum, to impose on the Turks the longest possible passive defence, since that was, materially, their most costly form of war. . . .

"We must not take Medina. The Turk was harmless there. In prison in Egypt he would cost us food and guards. We wanted him to stay at Medina, and every other distant place, in the largest numbers. Our ideal was to keep his railway just working, but only just, with the maximum of loss and discomfort. The factor of food would confine him to the railways, but he was welcome to the Hejaz Railway, and the Trans-Jordan railway, and the Palestine and Syrian railways for the duration of the war, so long as he gave us the other nine hundred and ninety-nine thousandths of the Arab world" (pp. 66–67).

It is not in its military bearings alone that "Revolt in the Desert" is of geographical value. The book is flooded with the lights and shades both of the Arabian landscape and of the Bedouin character. In short, sharp phrases Lawrence makes us know the type of man bred by the desert. Thus: "The Bedu were odd people. . . . Had the circumstances of their lives given them opportunity they would have been sheer sensualists. Their strength was the strength of men geographically beyond temptation: the poverty of Arabia made them simple, continent, enduring." With words of this sort Lawrence every now and again dips beneath the surface. A little like Doughty, he saw Arabia and the Arabs with the eye of a poet, and geography needs the insight of the poet no less than the method of the scientist.

North America and the Swedes

Helge Nelson. **Nordamerika: Natur, bygd och svenskbygd.** Vol. 1: **Allmän översikt: De stora dragen av Nordamerikas geografi.** 258 pp.; maps, ills.: Vol. 2: **Geografiska landskaps- och miljöskildringar,** pp. 259–526; maps, ills., bibliogr. A.-B. Magn. Bergvall, Stockholm, 1926. 7 kr., 50 öre a vol. 10 x 7 inches.

North America and the Swedes, as the title of the book might be rendered, is an admirable account of the physiography of North America north of the Rio Grande, with geographic landscapes always culminating in man, worked out for each region, or rather wrought into every part of the work.

Considering the limits of the book, it is astonishingly comprehensive, the Canadian portion being especially fresh and full. The author has written a larger book on Canada, "Canada nybyggarlandet" (Canada, settlers' country). The author's experience of the continent is a brief nine months' visit. Some of his social evaluations show this. It is questionable whether freedom of blacks to marry whites in

northern states had anything to do with bringing negroes north of late years, and the "open secret" some one has told him that black children are apt to occur disconcertingly in distinguished southern families is simply malicious slander. The black man has odd attraction for Europeans. Witness the full-page picture—a fine one—of two Pullman porters!

Generally the illustrations are fine—the author's own numerous photographs well taken and most intelligently conceived. The occasional maps are clear and good. Some of them are familiar but not well credited to sources.

But the leading motive of the book is the Swedes in America. Swedish-American Societies and the Government shared in Mr. Nelson's expenses on the trip, and so he visited the Swedes in all their strongholds. He finds them useful, prosperous, and respected; becoming rapidly Americanized; losing their mother tongue as soon as the second generation is established in contact with neighbors. There is a note of regret in the record of this loss of Swedish culture, and the reader gets the impression that the recent campaigns for Americanization are unfortunate and regrettable in the author's eyes, though he makes no definite comment of the sort and is generous enough to admit admirable American influences on the Swedish immigrant.

Probably it is difficult for a Swedish-American Society to conceive that an America sprinkled with little Swedens, little Italies, little Russias, and little Germanies, each with its home-village dialect, costumes, customs, and superstitions, could not be the America that so attracts European immigrants today. America, rich and powerful, is the object of widespread envy because of its wealth and power, but it is rich and powerful only because it is one great people. It has freed Swedes and Germans and Russians, to some extent at least, from narrow village prejudices, especially from the prejudice or superstition that they were born and destined for a lowly place in society and a life of subordination and discomfort; it has taught them to want and expect comforts that few in Europe ever attain and has taught them to work for them, as Nelson's Swedish Americans confessed to him they had worked, harder than they ever dreamed of working in the old country. It shocks Old World people to talk of Americanizing them, but the masses that have been Americanized think otherwise.

MARK JEFFERSON

THE ORIGIN OF OUR CHIEF TEMPERATE ZONE CROPS

N. I. VAVILOV. **Studies on the Origin of Cultivated Plants.** 248 pp.; maps, ills. *Bull. of Applied Botany and Plant-Breeding*, Vol. 26, No. 2. Institut de Botanique Appliquée et d'Amélioration des Plantes, Leningrad, 1926. In Russian with English translation.

The author of this book has presented his material in a clear, concise, and stimulating manner. The conclusions reached are backed in every case by a convincing array of facts and are quite distinct from those of earlier investigators. Based on a detailed study of the anatomy of the plants, their genetic behavior, their cytology, their distribution, and their diseases, he has convincingly presented the case of the centers of origin being marked by diversity.

The soft wheats are recognized as having 67 botanical varieties. While the whole of Europe does not show more than 15 or 20 varieties, in Persia and Afghanistan alone there are 50 varieties. Soft wheats appear to have been introduced only lately into Africa. Club wheat has a distribution similar to soft wheat and originated like the latter in the mountains of Afghanistan and southwestern Himalaya. Durum wheat, on the other hand, shows little diversity in Asia and is absent from most of the districts of southwestern Asia. Abyssinia, Algeria, and Greece, on the contrary, show all the features of polymorphism of durum wheat. Thus there are two distinct centers of distribution of wheat, the soft wheats from Asia and the durum wheats from North Africa.

Barley shows two chief regions of diversity: Algeria, Tunis, Morocco, Tripolitania, Arabia, Mesopotamia, and to a less degree Afghanistan; a second area in racial diversity is southeastern Asia, China, Japan, and the region about Tibet. Oats, which de Candolle regarded as of European origin, were not cultivated by the Jews nor the Egyptians. Cultivated oats, however, originated from a weed or wild species whose center of origin is difficult to locate, for it is not certainly European and may be partly Asian. There is also a variety of oat which originated in Abyssinia, another which originated in North Africa and the Mediterranean region, and still another, a naked-grained variety, which is distinctly Chinese. Of the millets, the center of greatest diversity is in Eastern Asia.

A most interesting chapter deals with weeds as the progenitors of the cultivated plants and discusses chiefly rye and oats. One of the astonishing features of rye is its remarkable homogeneity. A brittle form of rye occurs wild in fields of wheat and barley in Turkestan and Afghanistan. Southwestern Asia is the center of the diversity of rye. This same region gave rise to the soft and cultivated wheats. Here rye occurs as a weed of the brittle type and is not cultivated in Syria, Palestine, India, or China. As you pass from lower elevations to higher elevations in Afghanistan Hindu-Kush, and Bukhara, the conditions become increasingly difficult for the, success of wheat and barley and increasingly favorable to rye. In these mixed fields rye increases from as low as 3 per cent of the crop at 400 meters, to 39 per cent of the crop at 2000 meters. The same condition obtains as we pass north and west. As the barley and wheat crops were pushed out to the colder and poorer area, first, winter barley dropped out in Transcaucasia, Turkestan, and Transcaspia; and farther north in Siberia, European Russia, and Germany wheat dropped out and left rye as a pure crop. On the border line of this struggle between wheat and rye mixed plantings are often made. If the season is favorable for rye, then rye predominates; if favorable for wheat, then wheat predominates. Rye has, therefore, become a cultivated crop by being a weed which could not be eliminated; and, when the crop fails as we go north, the weed has taken its place.

Many examples of a similar nature are cited; and such, the author believes, was the origin of many of the cultivated groups. Plants that are noxious weeds in the south become important food crops in the north. The author classifies crops into primary crops—ancient crops—such as wheat, barley, rice, soy beans, flax, and cotton; and secondary crops, which have originated from weeds, such as rye and oats.

It is difficult to trace the origin of the primary crops. Crops showing great diversity are often limited to very rich soils, to places near human abode. When food becomes scarce, these wild grains of the non-shattering type are collected within their natural area first for food and as this is repeated ultimately pass into cultivation. This introduction into cultivation is natural and often involuntary. Barley probably originated from the weed *Hordeum spontaneum*, a plant which occurs in cultivated or disturbed places in rich, loose soil, rather than from the barley which grows on dry slopes far from the habitats of man. Aegilops closely approaches the soft wheats and readily crosses with them. It grows as a weed in the fields of wheat and barley and may have given rise to the former. Wild oats likewise grows as a weed. We may therefore look for the progenitor of our cultivated plants not in those which are distinctly different in their ecological requirements but in those which are weedlike and require conditions similar to cultivation.

The great centers of distribution of cultivated crops seem always to have been mountainous regions. While the historian and archeologist have generally supposed the river basins to have been the home of ancient man and cultivated plants, an examination of the crop plants has shown the mountains to have been the regions which have originated the greatest diversity. Not only are the plants here greatly diversified but the races of man likewise. There may be some correlation between these two sets of distributions. The most important regions have been mountains

adjacent to deserts where a great variety of conditions is to be found. Here are to be found protection, an abundance of water, and irrigation; and here, in all probability, primitive agriculture developed. The mountainous regions of the earth, which constitute a twentieth of its land area, support approximately nine hundred million people.

The great centers of distribution of cultivated plants recognized are:

(1) Southwestern Asia, India, southern Afghanistan, and the adjacent mountains of Bukhara, Kashmir, Persia, Asia Minor, and Transcaucasus. Here have originated the soft and club wheats, rye, small-seeded flax, small-grained peas, lentils, horse beans, vetchlings, chick-peas, and Asiatic cotton.

(2) Southeastern Asia, China, Japan, and Nepal. Here have originated naked oats, hull-less barley, millet, soy beans, many cruciferae, and many fruit trees.

(3) Mediterranean Egypt, Algiers, Tunis, Palestine, Syria, Greece, Spain, Italy, and western and southwestern Asia Minor. Here have originated durum wheats, Byzantine oats, large-seeded flax, large-grained pea, vetchlings, horse beans, lentils, beetroot, and many vegetables and fruit trees.

(4) North Africa, Abyssinia. Here were produced hull-less barley, violet-grained wheat, original races of peas, peculiar varieties of oats, and many endemic plants.

(5) New World, Mexico, and the mountains of Peru. Here were produced potatoes, Jerusalem artichokes, corn, beans, tobacco, the sunflower, American cotton, vegetables, and fruits.

A possible sixth center is indicated as the Philippines, where rice and Coix may have originated.

Although the author has not considered in this paper the origin of many important tropical crops, he has given us a most stimulating picture of the probable origin of our important temperate crops and has led the way to a method of discovering "the strongholds hiding the origin of species." These conclusions are based on extensive travel and personal study. He has, likewise, shown the importance of a scientific attack on the practical problems of the origin of new varieties of cultivated crops.

H. L. Shantz

Volcanism in New Zealand

J. Allen Thomson. **Volcanoes of the New Zealand-Tonga Volcanic Zone: A Record of Eruptions.** Ills., bibliogr. *New Zealand Journ. of Sci. and Technol.*, Vol. 8, 1926, pp. 354–371. Wellington.

J. A. Bartrum. **White Island Volcano.** Ills. *Ibid.*, pp. 261–266.

From a little south of the middle of the north island of New Zealand, and extending for nearly 2000 miles in a north-northeasterly direction to the Tonga Islands, there is a line of volcanoes in various degrees of activity. These volcanoes lie on the summit or on the western slope of what appears to be a ridge of "continental rock," which slopes gently towards the west but descends steeply towards the east into the narrow Kermadec and Tonga Deeps. This ridge is an important tectonic feature. The volcanoes on it are composed almost entirely of andesitic rocks; whereas the volcanic rocks on the islands east of it are practically made up only of basaltic and related rocks. It has been suggested that the ridge extends 2500 miles farther to the Hawaiian Islands: but Thomson gives good reasons for disbelieving this; he thinks that it may bend to the northwest near the Tonga Islands and form the platform of the Ellice, Gilbert, and Marshall Islands. He also thinks that this ridge may represent the true western boundary of the Pacific Ocean in its neighborhood. I suppose Thomson may be pardoned for ascribing the ridge to a line of weakness and the volcanic activity to relief of pressure, these expressions are so common in geologic

literature; but they are merely a sword to cut the Gordian knot which geologists and geophysicists have not been able to unravel.

All the volcanoes and solfataras are described, and an account is given of their activities so far as they are known. Few observations go back so much as 100 years; most are quite recent. What eruptions have occurred were explosive; and the different craters have erupted independently. Although sections of lava sheets can be seen in some craters, no lava flows have been certainly seen; but in some cases the red glow on the ejected steam indicates the presence of liquid lava in the crater. The Tarawera eruptions of 1886 are described; at that time some twenty-one new craters erupted along a line eight and three-quarters miles long. The fact that only fumarolic action had been seen here before this eruption leads Thomson to the conclusion that "hot springs, geysers, and steam jets are not necessarily signs of the waning activity of an expiring volcano, but may be signs of a rising lava-column in new ground."

The paper ends with a chronological list of known eruptions, which is recognized as incomplete, and with a bibliography.

Bartrum's paper, although published earlier, is really supplementary to Thomson's. It is a special description of White Island Volcano which rises in the Bay of Plenty on the north shore of New Zealand. The crater is breached on the eastern side but elsewhere is bounded by precipitous cliffs more than 1000 feet high. The floor of the crater is only about 40 feet above sea level; fumaroles exist in the floor and are more concentrated near its boundaries. There are considerable sulphur deposits which are being exploited. In 1914 a disaster killed all the operatives. Recently (1926) inaccurate newspaper reports led Jaggar to suggest that engulfment was taking place and that an approaching eruption was indicated. Bartrum examined the volcano especially with this idea in view. He concluded that the 1914 disaster was not due to an eruption but to landslides from the crater walls and a mud flow in the crater floor. Cracks exist in the walls, and some movement is going on. He fails to find evidence of any impending eruption.

HARRY FIELDING REID

THE CAUSES OF CLIMATIC CHANGE

C. E. P. BROOKS. **Climate through the Ages: A Study of the Climatic Factors and Their Variations.** 439 pp., maps, diagrs., bibliogr., index. Ernest Benn Ltd., London, 1926. 16s. 8½ x 6 inches.

"Climate through the Ages" is a companion volume to "The Evolution of Climate" by the same author. It is a treatment of the climates in the earth's history from the meteorological point of view.

The first part, "The Climatic Factors and Their Variation," is essentially a textbook in meteorology. The great climatic changes are held to have been due to the operation of a number of different factors acting in the same direction. The dominant factors have always been geographical—the word taken in a very wide sense including distribution of land and sea, ocean currents, vertical circulation of the ocean, general elevation of the land, and volcanic activity. Non-geographical factors—astronomical, solar—have had only minor effects. Changes in the solar activity influenced the melting of the Pleistocene ice sheets, as recorded by the varved clays, and have caused small climatic fluctuations during the past two thousand years.

The second part, "Geological Climates and Their Causes," is an application of the author's views on the climatic factors. It is inferred that the climates of the past can be tolerably well explained by the distribution of land and sea, mountain ranges, ocean currents, etc., without resort to drift of the continents in Wegener's sense.

The third part treats the climates of the historical past, from about 5000 B. C. till the present. It is based on data from all parts of the northern hemisphere, such as

historical records, migration of peoples, growth in thickness of trees, variations in levels of lakes, and floods of the Nile. There were several distinct fluctuations, some embracing wide areas, others local in character.

The climatic factors are so numerous and their possible rôles and combinations so varying and many that the results of a study of the past climates, which have no correspondence or only partial correspondence in the existing climates, will be markedly influenced by the way of approach. The meteorological approach, employed in the present volume, naturally tends to lead to a possible explanation rather than to *the* explanation. Approach from actual knowledge of the climatic conditions during the late-glacial and postglacial ages would give another and probably truer valuation of the relative importance of the climatic factors. The halts in the retreat of the last ice sheets, caused essentially or entirely by low summer temperature, were largely independent of physiographic alterations. So, too, were the cessation of growth and the beginning of waning of the ice caps, and very probably even their beginning of growth, for northern Europe and North America held practically the same stand relative to sea level during the last interglacial epoch as they do today, and no other essential physiographic differences may have existed. The same also holds true for the postglacial climatic changes in Scandinavia and in North America. The late Quaternary climatic changes in the glaciated areas were thus not mainly due to geographic alterations. The relationship that existed was essentially reversed. Climate on the whole was cause, and physiographic changes were consequence. The chief relationship was: temperature rise, waning of the ice sheets, rise of the glaciated lands. The climatic changes at least during the latter part of the Quaternary may have been largely due to non-geographical factors, while the generally low temperature during the Quaternary epoch was due to geographic factors, primarily the mountain building in the Tertiary. The rôle in general of the geographical factors may be overestimated by Brooks.

However, different views on problems so little understood are but natural. The book is a bold and remarkable piece of work.

ERNST ANTEVS

CONTRIBUTIONS TO HYDROGRAPHY AND MARITIME METEOROLOGY

Köppen-Heft der Annalen der Hydrographie und Maritimen Meteorologie. 109 pp.; maps, diagrs., ills., bibliogr. Deutsche Seewarte. E. S. Mittler & Son, Berlin, 1926. 10½ x 7½ inches.

Twenty-one authors contribute timely articles on modern meteorology and climatology to this *Festschrift* to Dr. Wladimir Köppen on the occasion of his 80th birthday. Though the book has a strongly marine flavor, it comprises a wide sampling of modern meteorology by leading investigators.

A fine photograph of Dr. Köppen comes first, and an appropriate dedication. Dr. Köppen was born in St. Petersburg, son of an eminent Russian ethnographer, statistician, and antiquarian. Young Köppen's first scientific interest was botany, which he used so effectively later, in his classification of climates. In 1875 he went to the Deutsche Seewarte where he was first in charge of the weather service for four years, then more or less a free-lance investigator and, beginning in 1898, originator and director of the great aerological work of the Observatory. He was the first editor of the *Meteorologische Zeitschrift*. Among Köppen's almost countless published contributions, of which there have been as many as 108 in the past ten years, half of them climatology, the following are specially deserving of mention here: the daily period of wind velocity (Espy-Köppen), movement of barometric depressions, thunderstorms and squalls, clouds, his well-known beautiful wind charts of the oceans, his extraordinarily comprehensive classification of climates, and, recently, the studies of paleoclimatology in which he supports the revolutionary ideas of his son-in-law and colleague, Dr. Alfred Wegener.

Some of the discussions making up the Köppen-Heft may be briefly mentioned. Dr. E. van Everdingen (pp. 18–19) criticizes Dr. Hobbs' theory of stationary glacial anticyclones and shows that without the observed temporary displacements of the anticyclones precipitation would be inadequate for the maintenance of the ice caps. Five other papers touch problems of world weather or long-range forecasting. A. Defant presents numerical magnitudes for the atmospheric and oceanic exchanges from latitude to latitude (pp. 12–17). W. Grosse points to the elevation of annual mean temperatures in western Europe in recent decades, and, on the basis of progressive changes in the sequence of Brückner cycles, makes pentad forecasts of temperature and rainfall for Bremen (pp. 38–41, plate). Sir Napier Shaw urges the reservation of the term "centers of action" for those places where change of mass through the effect of convection (warming or cooling) takes place, e. g., Grand Banks and western Mediterranean in winter, rather than simply statistical highs and lows. Monthly maps of the North Atlantic showing differences between air and sea temperatures illustrate his point (pp. 85–88). A. Wallén describes his long-range forecasts of precipitation and lake levels in Sweden, based on the 28-month and 11.2-year cycles (pp. 89–92). L. Weickmann analyzes pressure waves over the northern hemisphere, particularly the circumpolar ones of 24 days (pp. 99–104, plate). Marine meteorology, aerology, and climatology are also well represented in this excellent collection—a fitting honor to a great meteorologist.

CHARLES F. BROOKS

COLONIAL ETHNOLOGY IN RELATION TO NATIVE POLICY

J. C. VAN EERDE. **Kolonial Volkenkunde, Eerste Stuk: Omgang met Inlanders** [Colonial Ethnology, Part I: Social Intercourse with Natives]. (Koninklijk Koloniaal Instituut te Amsterdam. Mededeeling No. 1. Afdeeling Volkenkunde No. 1.) 4th edit. ix and 181 pp.; ills., index. Amsterdam, 1926.

Professor van Eerde has given, not only to the Dutch but also to all colonizing countries, a very valuable book discussing the way we white people should behave towards the natives we have under our care. The number of reprintings (the book was first published in 1913 and last revised in 1926) indicates the great interest the Dutch public, especially those connected in some way with the colonies, take in these problems. In these days of unrest over all the Far East, in the days when the democratic countries are sometimes hesitant over their colonial policy—compare the American attitude toward the Philippine Islands—this presentation by one of the greatest of the Dutch ethnological experts has a particular value. Professor van Eerde gives not only his own point of view but shows how the Dutch government working along the same line is trying to improve the relations between whites and natives. The basis is mutual understanding, and the government asks from its officials a good knowledge of the native language and of the native ways of thinking. And so in his last chapter, Professor van Eerde dwells on the great importance of practical ethnology not only for the scientist but also for all those who work for better material understanding. It is regrettable that a book of this value has not yet been translated into English.

S. VAN VALKENBURG

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